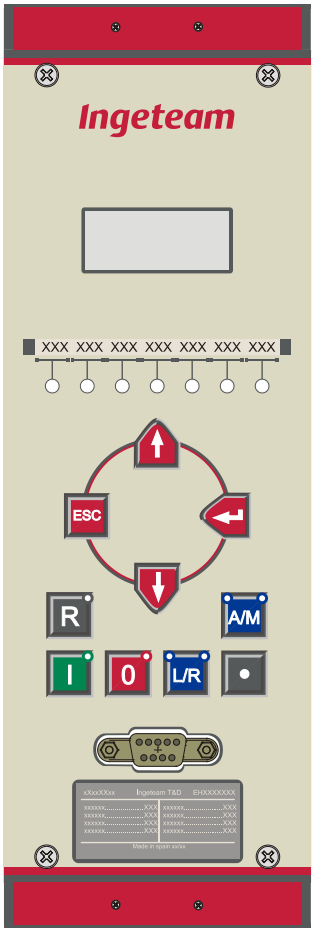
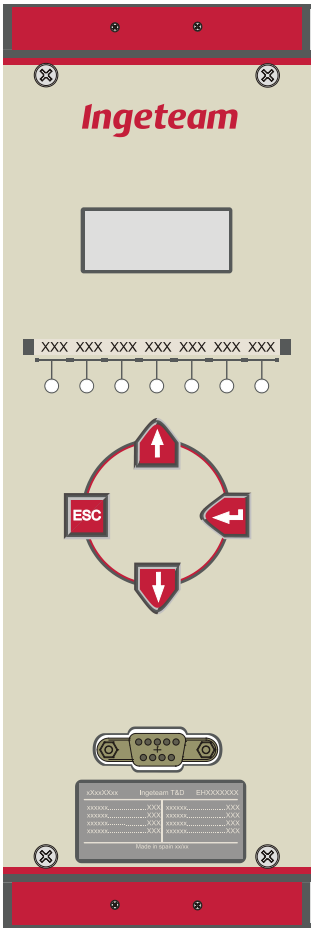
PL70 PROTECTION

INSTRUCTION MANUAL





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UME_PL70_eng Rev.: K (06/11)

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GENERAL DESCRIPTION

The PL-70 family units are numerical multi-function protection relays and they constitute the basic protection, measurement and control element for cogeneration facilities or for HV/MV electrical bays. They may be employed as a self-standing protection, control and measurement elements for an electrical bay or integrated into an Integrated Protection and Control System.

The range includes various families that differ to each other in terms of hardware and functionality. The Firmware is common to all the models; the available functions for the user in each model are defined in a programmable logic circuit (PLD). The Firmware can be loaded into the units through the serial port, thus facilitating the updating of versions.

1.1 SCOPE OF THE MANUAL

This manual does not correspond to any one specific PL70, but rather is applicable to all the available families. Only the physical characteristics and functions of each individual model are covered. The manual consists of two volumes: the first contains the information regarding configuration, functions etc., and the second contains the following appendixes: curves for the operation of the timed functions, communication protocols, keyboard/display menu structure, etc.

Additionally, ach unit is supplied with a summarized "Characteristics sheet", which details the functions of the specific model and its interconnections diagram.

1.2 FUNCTIONS

Protection

The following table shows the protection functions incorporated into each family.

Functions	IT	IS	IA	ID	IP	NT	IM	RT	FI	TH	TF	TT	SV	SY	PC	PO	IV	MO	CT	SC	RS	RC
50/51	X	X			X		X										X	X				X*
50 HIGH1	O	O																				
50/51 HIGH2	O	O																				
49	X	X			X		X	X									X	X				
46, 46FA	X	X			X												X	X				
50/51N	X	X			X	X												X				X*
50N HIGH1	O																					
50/51N HIGH2	O	O																				
50/51NS	X	X																				X*
50NS HIGH1		O																				
50/51NS HIGH2	O	O																				
50/51R	X	X			X												X	X				
50/51N2						X		X														
50/51N3						X																
51V																	X					
50BF	X	X		X	X	X	X	X	X								X	X				
87N					X	X												O				
67N				X																		
67NA			X																			
CLP	O	O																				
79	O	O																				
27											X	X	X	X								
59											X	X	X									
47												X	X									
78													X									
25														X								
81											X	X	X									
81R											X	X	X									
64/59N										X		X	X									
40															X							
24						X																
32																X						
51RB,37,48,66																		X				
37 2 Levels	X	X																				

Functions	IT	IS	IA	ID	IP	NT	IM	RT	FI	TH	TF	TT	SV	SY	PC	PO	IV	MO	CT	SC	RS	RC
DPF																				X	X	X**
DPF Directional																					X	
Autom. Sect.																				X	X	
Slack spring																			X	X	X	X**

Note 1: X: Available function O: Optional function
Note 2 IT and IS family: The 50/51N and 50/51NS functions are effected on the neutral measurement, in the case of the IT family, and on the sensitive neutral, in the case of the IS family.
Note 3: RC Family: The 50/51N and 50/51NS functions are performed on the neutral measurement.
Note 4: *: Unit in reconnector mode.
Note 5 **: Unit in breaker mode.
Note 6 IT and IS family: The 50/51N HIGH2 and 50/51NS HIGH2 functions are effected on the neutral measurement, in the case of the IT family, and on the sensitive neutral, in the case of the IS family.

Automatisms

Functions depending on model

The three-phase recloser, as shown in the functions table, is optional in IT and IS families.

Breaker automatism. Available in SC and RS families.

Measurements

Measurements	IT	IS	IA	ID	IP	NT	IM	RT	FI	TH	TF	TT	SV	SY	PC	PO	IV	MO	CT	SC	RS	RC
IA	X	X			X		X		X						X	X	X	X	X	X	X	X
IB	X*	X*			X				X								X	X				
IC	X	X			X				X								X	X		X	X	X
IN	X			X	X	X		X	X									X		X	X	X
INS		X	X																			
IN2						X																
IN3						X																
VA												X	X	X	X						X	
VB												X	X	X	X						X	
VC												X	X		X						X	
V comp						X					X					X	X		X	X		X
VN			X	X						X		X	X									

Note 1 IT and IS family: If the adjustment of current phase B is calculate, the measure B made with the measures of transformers A, C and neutral, regardless of what is injected into the transformer B. If the setting is transformer, the measure of phase B it will be injected into the transformer B.

Data acquisition

Event recording

Fault recording

Maximum and minimum measurement recording

Oscillograph data recorder (available as option)

Other characteristics

Settings tables. Except for the configuration settings, which are single table settings, there are 4 tables for the various setting tables (available as option); one of these tables is active or operative at any given time. The active table can be selected by an order sent via keyboard/display (in “Change settings”), by an order sent via a message from the Protection Console, or by the activation of a digital input.

1.3 SELECTION OF OPERATING MODE BREAKER / RECLOSER (RC FAMILY)

The RC family allows two operating modes:

Breaker mode:

In this mode, the current passover detection functions are operative (if enabled). It does not require any type of protection or recloser. The (“R) key’s control and operating orders corresponding to the recloser are not operative.

Reconnector mode

In this mode, the unit carries out protection functions (if enabled) and the recloser function is operative (if enabled). The current passover due to fault detection functions are not operative in this mode.

There are three ways to switch from one mode to another:

Through the digital input programmed as "Protections in service / out of service". This input is activated by flanks. If it detects a rising slope, the unit is configured as a reconnector. If it detects a new rising slope, it is configured as a breaker.

By means of a control order. There are 2 control commands that configure the unit as a recloser or as a breaker.

By pressing the key ("P"), the unit switches from one mode to another.

The mode settings are stored in a non-volatile memory. Therefore, when the unit is switched on once again it starts in the mode in which it was operating prior to being switched off.

1.4 MODEL CODING

The following models are defined within the PL70 protection family:

PL70 MODEL

OPTIONS	
Three phase and neutral overcurrent protection	IT
Sensitive neutral overcurrent protection	IS
Isolated neutral directional overcurrent protection	IA
Neutral directional overcurrent protection	ID
Three phase overcurrent and restricted earth protection	IP
Overexcitation protection and fault to earth detection	NT
Single-phase overcurrent protection	IM
Thermal image protection	RT
Breaker failure protection	FI
Homopolar sequence voltage protection	TH
Single phase voltage and frequency protection	TF
Three phase voltage and frequency protection	TT
Network decoupling protection	SV
Synchrocheck	SY
Generator loss of field protection	PC
Power protection	PO
Voltage controlled overcurrent protection	IV
Motor protection	MO
Automation function for control of isolating switches	SC
Automation function for transformation centres	CT
Protection and automation for reclosers	RC
Control and automation for transformer substation switch disconnectors	RS

IT MODELS PARTICULAR CODE	
Basic with IN range from 100mA to 100A	A
Basic + 2nd 50/50N/51/51N + 3nd 50/50N + CLP +79 with IN range from 100mA to 100A	B
Basic with IN range from 20mA to 20A	C
Basic + 2nd 50/50N/51/51N + 3nd 50/50N + CLP +79 with IN range from 20mA to 20A	D

IS MODELS PARTICULAR CODE	
Basic with ISN range from 5mA to 5A	A
Basic + 2nd 50/50SN/51/51SN + 3nd 50/50SN + CLP +79 with ISN range from 5mA to 5A	B
Basic with ISN range from 20mA to 20A	C
Basic + 2nd 50/50SN/51/51SN + 3nd 50/50SN + CLP +79 with ISN range from 20mA to 20A	D

MO MODEL PARTICULAR CODE	
Basic	A
Basic + 87N	B

SC MODEL PARTICULAR CODE	
With VT input and CT inputs with range of IN from 8mA to 3A	A
With capacitive divider input and CT inputs with range of IN from 8mA to 3A	B
With VT input and CT inputs with range of IN from 2mA to 2A	C
With capacitive divider input and CT inputs with range of IN from 2mA to 2A	D

RC MODEL PARTICULAR CODE	
With VT input and CT inputs with range of IN from 8mA to 3A	A
With VT input and CT inputs with range of IN from 2mA to 2A	C

RT MODEL PARTICULAR CODE	
CT input with range from 100mA to 100A	A
CT input with range from 20mA to 20A	C

RS MODEL PARTICULAR CODE	
With capacitive divider inputs and CT inputs with range of IN from 2mA to 2A	D

OTHER MODELS	
Basic	A

ADDITIONAL FUNCTIONS	
Basic	0
Oscillography + 4 setting groups	1

EXTENSION MODULE		
No module	Note 4	0
6 DI + 5 DO	Note 9	1
5 DI + 5 DO + IRIG-B	Note 9	2
6 DI + 3 analog inputs for voltage	Note 7	3
5 DI + IRIG-B input + 3 analog inputs for voltage	Note 7	4

POWER SUPPLY AND DIGITAL INPUTS		
220 Vac	Note 6	W
12 Vdc		X
24-48 Vdc		Y
110-125-220 Vdc		Z

ANALOG INPUTS TERMINALS		
Pin type standard terminals		1
Ring type terminals	Note 8	2

REAR COMMUNICATION PORT COM-1	Note 1	
No port	Note 2	0
RS232		1
GFO (Glass fiber optic)		2
PFO (Plastic fiber optic)		3
RS485		4
Ethernet RJ45	Note 5	5

REAR COMMUNICATION PORT COM-2	Note 1
No port	0
RS232	1
GFO (Glass fiber optic)	2
PFO (Plastic fiber optic)	3
RS485	4

BATTERY VOLTAGE MEASUREMENT	Note 3
None	0
Battery voltage measurement	1

VARIOUS	
With transparent lid	-
Without lid	0
With IP54 lid	1

Note 1: Programmable protocol, One of the ports COM-1 or COM-2 has to be PROCOME
Note 2: Only valid when there is not COM-2 communication port
Note 3: Battery voltage measurement only available if there is extension module
Note 4: Option not valid for PL70 FI and RS
Note 5: Available for all models of PL70 devices with 12 Vdc, 24-48 Vdc or 110-125-220 Vdc power supply except SV, TT, SY, TF, NT, TH.
Note 6: This option has inputs of 125 Vdc.
Note 7: Option allowable only for PL70 RS.
Note 8: In PL70 RS option only valid for current circuits.
Note 9: Option not valid for PL70 RS.

1.5 USER INTERFACE

Local. The front board is equipped with

4-key keyboard (10 keys in SC, RC, RS and CT families)

2-row (8-characters per row) display

6 red LED and one green/red LED

RS232 connector for direct connection with a PC. Procome protocol.

The front communication port has a temporary use, both for start-up and for maintenance. Maximum cable length 2m.

Remote. Depending on the model, the rear board has one or two Glass Fibre Optic (ST type connector), Plastic Fibre Optic, RS232 or RS485 ports for connection to PC, modem or Substation Control Unit (in Integrated Systems). The protocol can be Procome, DNP 3.0, MODBUS or IEC 870-5-103. In the SC and CT families, the available protocols are Gestel, PID1, SAP20, DNP 3.0 and IEC-101.

Models equipped with an Ethernet (RJ45) port, Procome TCP/IP protocol and, for SC, RC, RS and CT families, IEC-104 TCP/IP are available.

1.6 HARDWARE CONFIGURATION

The different Hardware options available for the specific models are as follows:

Terminals:

Torque of terminals mounted on the rear panel.

Supply terminals

Minimum: 0.5 Nm (5 in-lb)

Maximum: 0.8 Nm (7 in-lb)

I/O terminals:

Minimum: 0.5 Nm (5 in-lb)

Maximum: 0.8 Nm (7 in-lb)

Current and voltage terminals (plug-in connector)

Minimum: 0.5 Nm (5 in-lb)

Maximum: 0.8 Nm (7 in-lb)

Current and voltage terminals (closed terminals)

Minimum: 0.5 Nm (5 in-lb)

Maximum: 1.3 Nm (12 in-lb)

Terminal wiring

The terminal cables must be made of single-section copper AWG 12 to 18 (4 mm^2 to 0.8mm2)

Supply terminals

Section AWG 16 to 14 cables (1.5 to 2 mm2)

I/O terminals:

Section AWG 16 to 14 cables (1.5 to 2 mm2)

Current and voltage terminals

Section AWG 12 cables (4 mm2)

RS family voltage terminals

Section AWG 16 to 14 cables (1.5 to 2 mm2)

Unit power supply voltage

125/220 Vdc

24/48 Vdc

12 Vdc

220 Vac

Digital input voltage range

Extended (high 125/220 Vdc): 86 to 280 Vdc. Inactive below 60 Vdc

Extended (low 24/48 Vdc): 20 to 160 Vdc. Inactive below 13 Vdc

12Vdc: 9 to 24 Vdc Inactive below 7 Vdc

Number of digital inputs/outputs

Standard:

2 inputs (all independent)

6 outputs (5 independent, 1 switched)

Extended: add to the standard

6 inputs (all independent)

5 outputs (all independent)

Note: RS family is always equipped with an expansion card, 6 inputs (all independent).

Rear communication

All possible combinations. A COM1 port is necessary for the existence of a COM·2 port.

In the case of two rear ports, the second port is in parallel with the front RS232 (they occupy the same port).

Analogue inputs

The unit can have up to 4 analogue inputs (through transformer).

The RS family is equipped with 6 analogue inputs (through transformer).

The position of each metering transformer can be checked in each family's corresponding wiring diagram.

1.7 ENVIRONMENTAL CONDITIONS

Operating temperature

24-48 Vdc supply units	-20º to 65ºC
125-220 Vdc supply units	-20º to 60ºC
12 Vdc supply units	-20ºC to 70ºC
220 Vac supply units	-20ºC to 70ºC

The LCD contrast is not operative at temperatures below -20º and above 70ºC.

Storage temperature	-40 to 85 ºC
Relative Humidity	Up to 95% without condensation

1.8 TESTS

Electrical tests

Dielectric rigidity	acc / IEC255-5, class III (2 kV, 1 minute)
Insulation resistance	acc /IEC 255-5, >10 Giga-ohms at 500 Vdc
Pulse (shock wave)	acc / EN -255-5-5, class III
HF disturbances	acc / IEC -255-22-1, class III
Fast transients (bursts)	acc / IEC 61000-4-4, class IV
Electrostatic discharges	acc / IEC 61000-4-2, class IV
Voltage pulses(surge)	acc / IEC 61000-4-5, class IV
Micro-cuts	acc / IEC 61000-4-29, 100ms at 125 Vdc
Radiated electromagnetic interference	acc / EN 55011
Immunity to radiated fields	acc / IEC 61000-4-3, class III
Immunity to conducted radiofrequency signals	acc / IEC 61000-4-6, class III
Immunity to low frequency radiated fields	acc /IEC 61000-4-8.

Environmental tests

Cold	acc /IEC 68-2-1, (-40°C)
Dry heat	acc / IEC 68-2-2 (+85ºC)
Damp heat	acc / IEC 68-2-3 (+70ºC, 93% Relative humidity)
Thermal shock	acc / IEC 68-2-14 (-20º/70ºC. 2 4-hour cycles)
Operating range	-10ºC to 55ºC

Mechanical tests

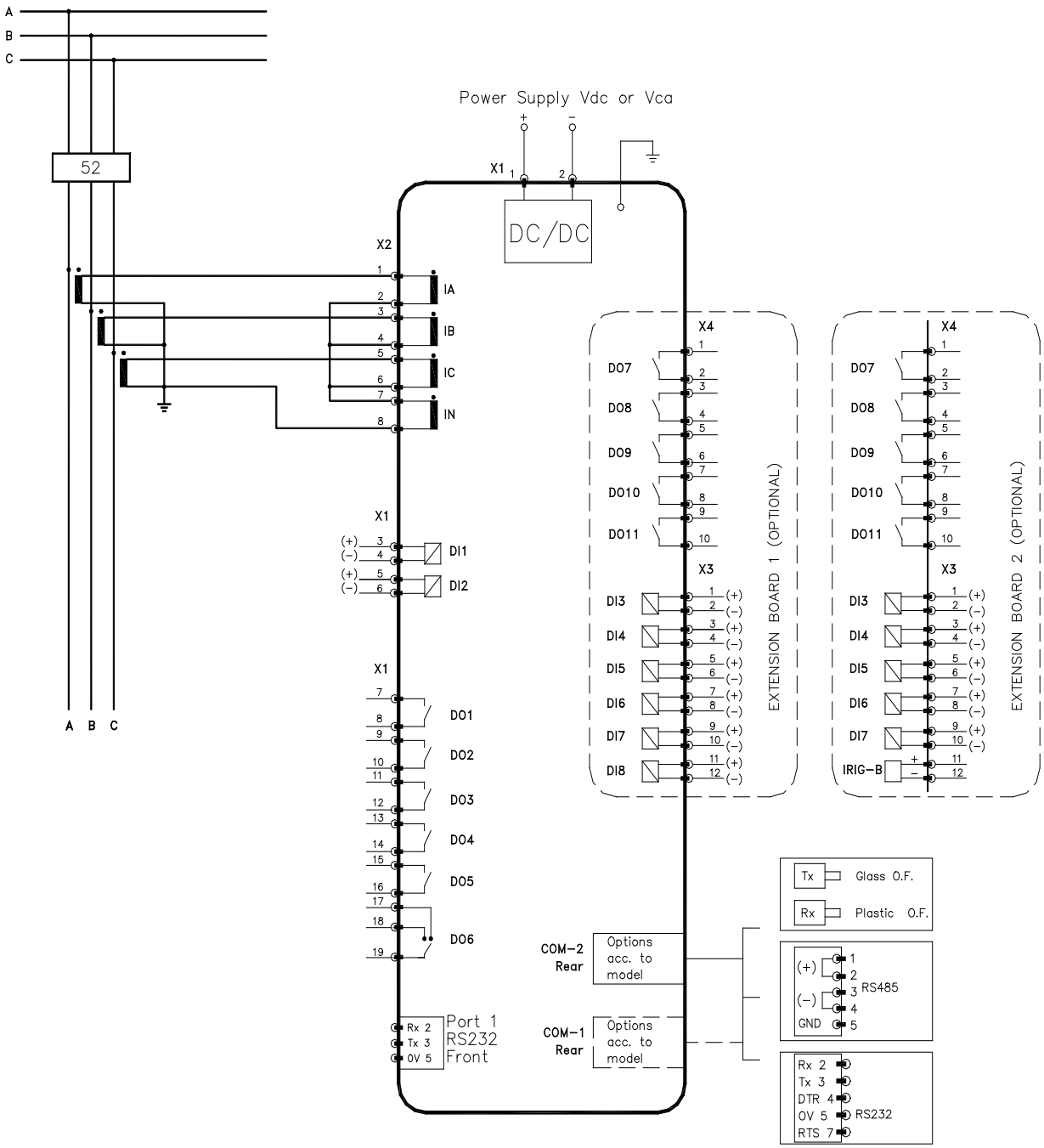
Vibration tests	acc / IEC 255–21-1 class II
Shock and bump tests	acc / IEC 255-21-2 class I

1.9 WIRING DIAGRAMS

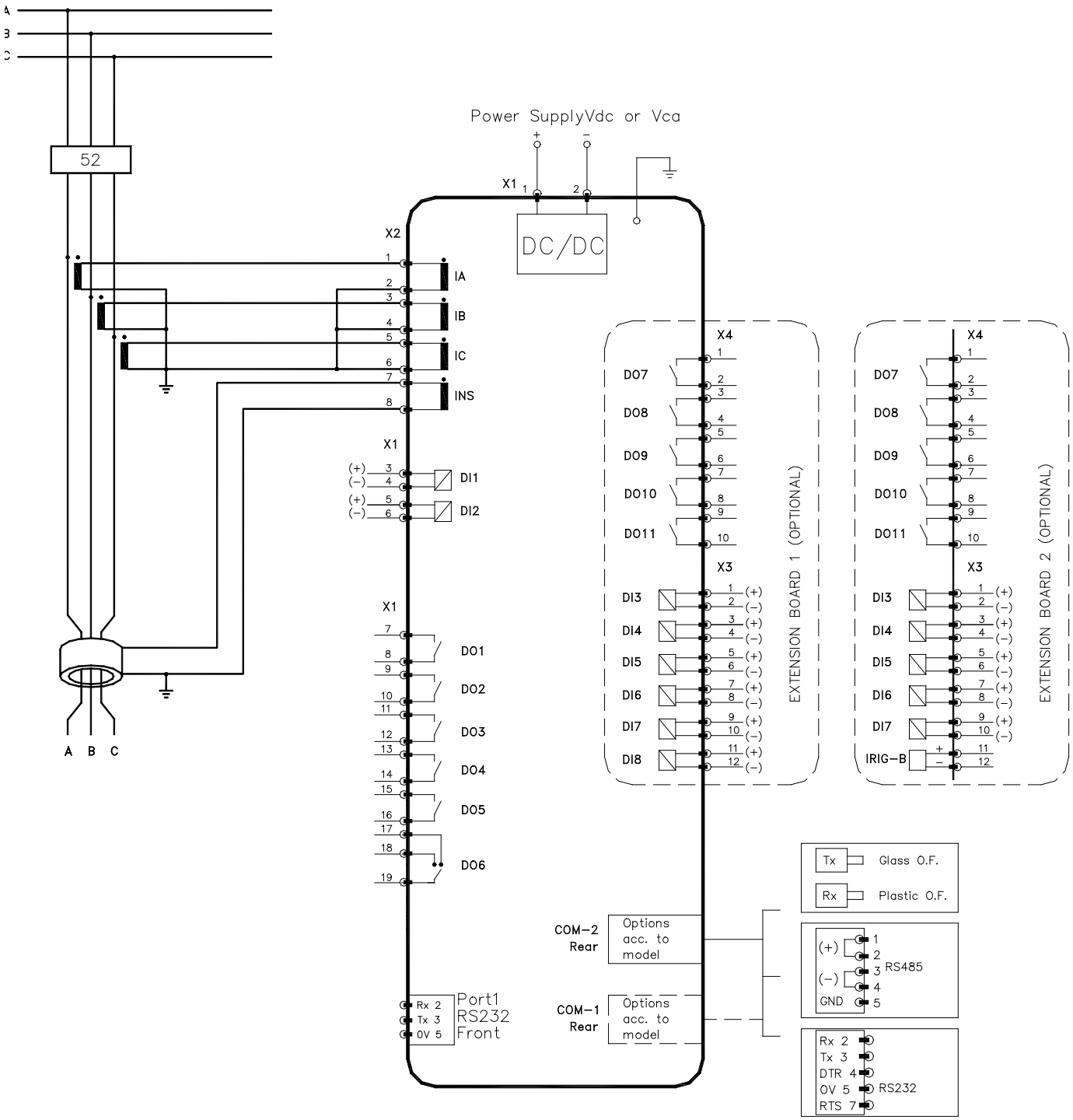
All the figures below show only one of the possible digital input and output programming options (very simple). Consult the other options in the “Digital input programming” and “Digital output programming” sections.

The phase sequence order is programmable by keyboard/display. (See “Other settings”- “Special settings”).

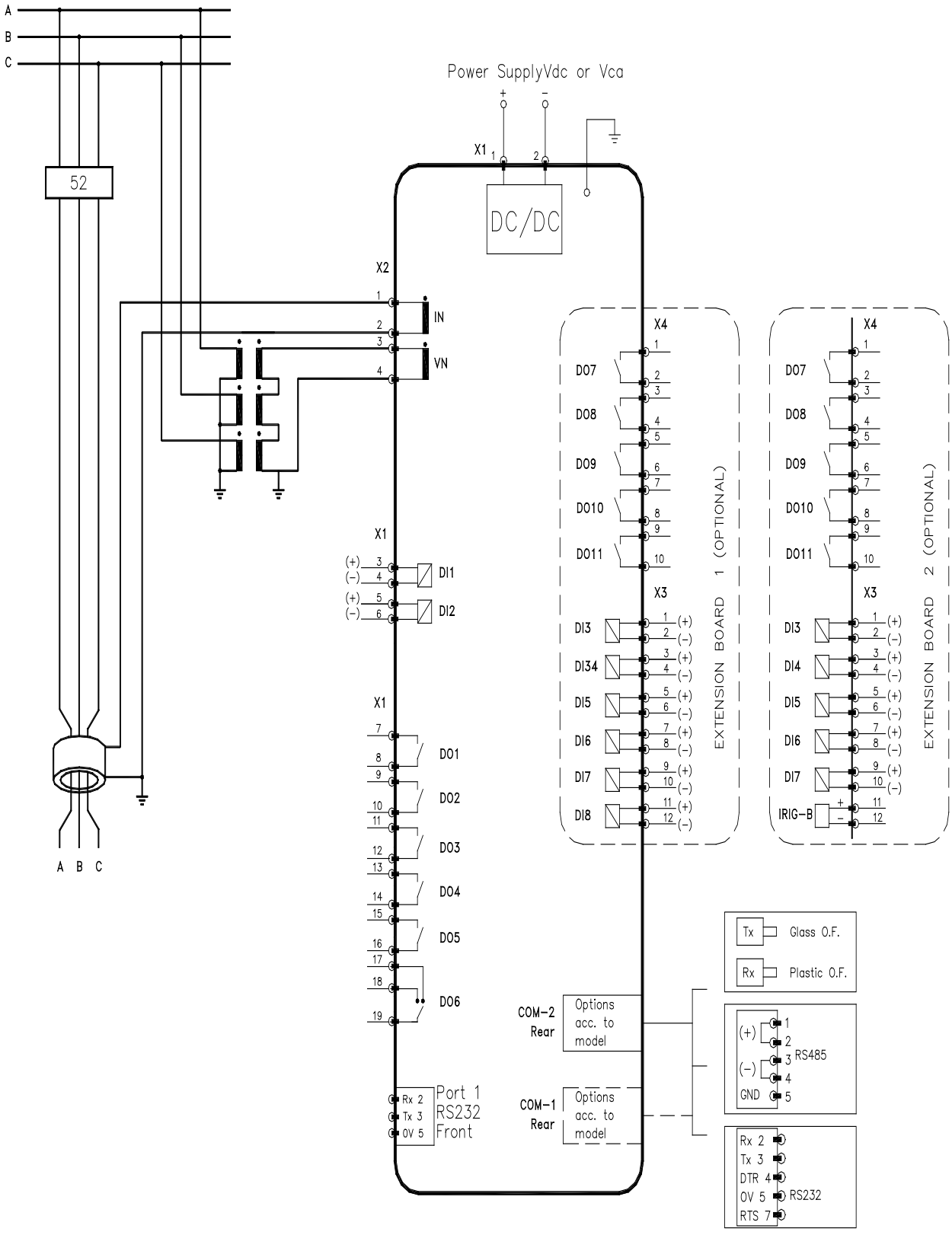
IT Family



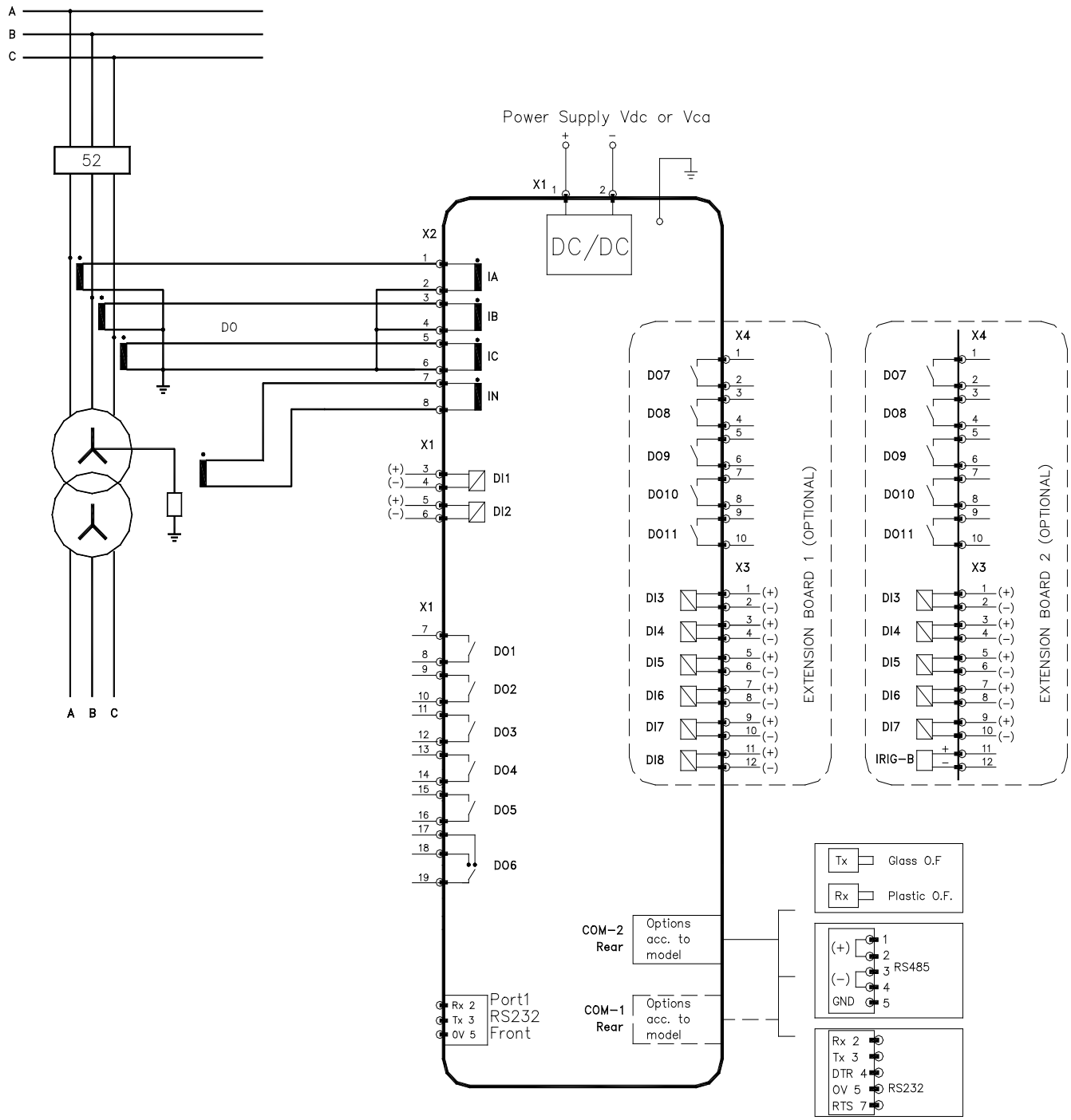
IS Family


A
B
C
52
A B C
Power SupplyVdc or Vca
+
–
X1
1
2
DC/DC
X2
1
2
3
4
5
6
7
8
IA
IB
IC
INS
X1
(+) 3
(–) 4
(+) 5
(–) 6
DI1
DI2
X1
7
8
9
10
11
12
13
14
15
16
17
18
19
DO1
DO2
DO3
DO4
DO5
DO6
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG–B
EXTENSION BOARD 2 (OPTIONAL)
Rx 2
Tx 3
0V 5
Port1
RS232
Front
COM–2
Rear
Options
acc. to
model
COM–1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(–)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

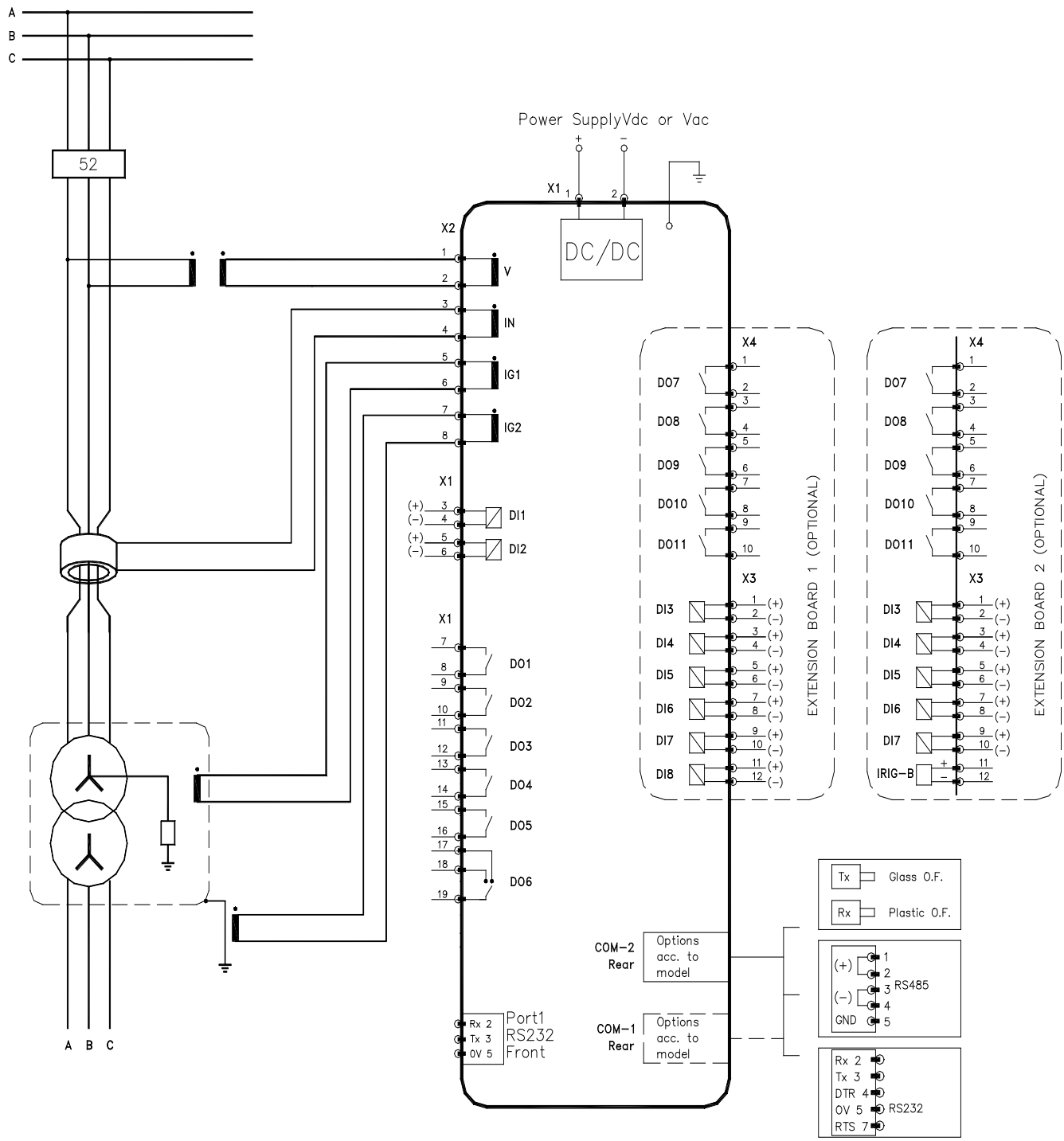
ID, IA Families



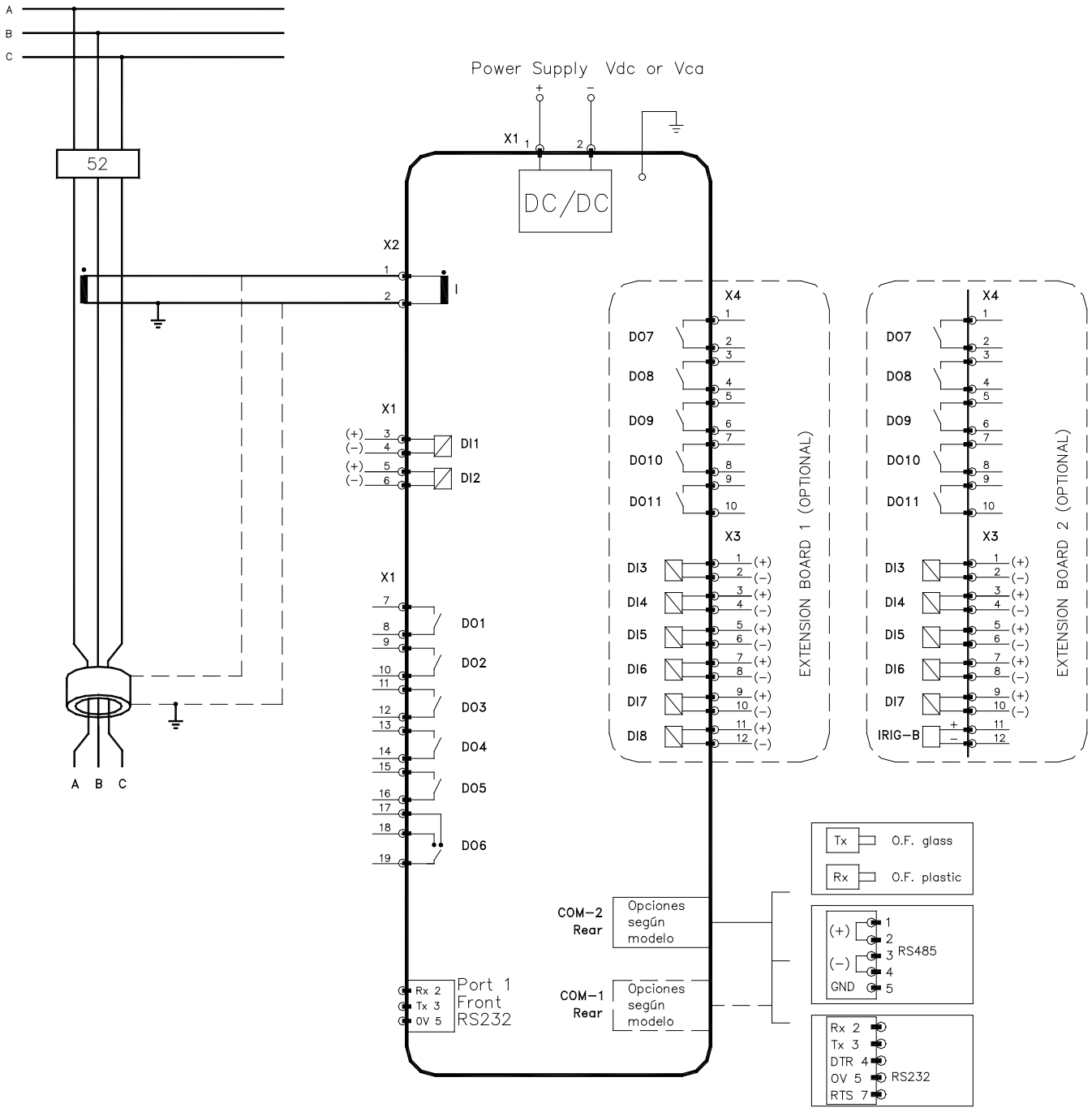
IP Family


A
B
C
52
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
IA
IB
IC
IN
DO
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Tx
Glass O.F
Rx
Plastic O.F.
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
(+)
(-)
GND
RS485
Rx 2
Tx 3
0V 5
Port1
RS232
Front
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

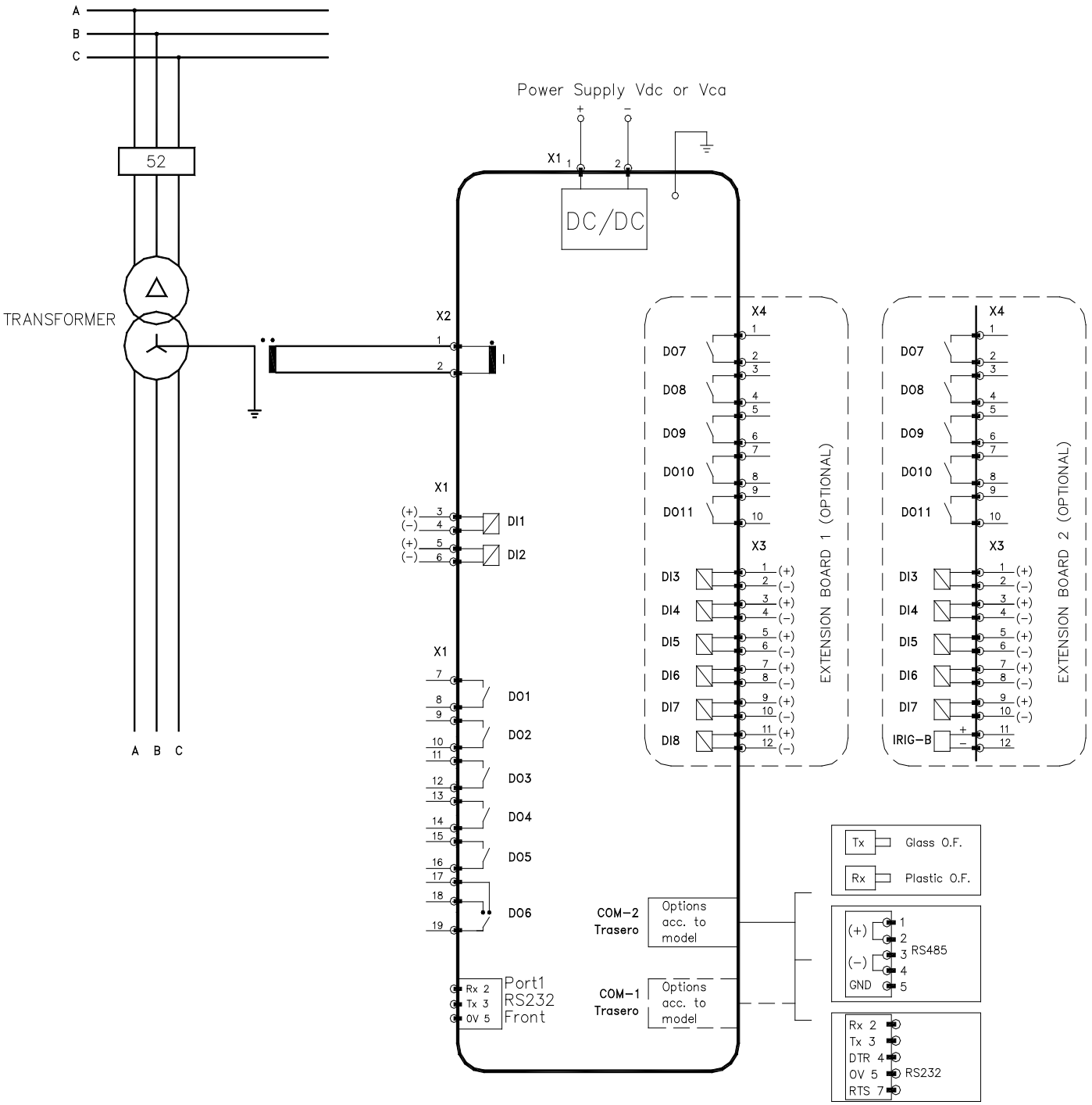
NT Family


A
B
C
52
Power SupplyVdc or Vac
+
−
X1
1
2
DC/DC
X2
1
2
V
3
4
IN
5
6
IG1
7
8
IG2
X1
(+) 3
(−) 4
DI1
(+) 5
(−) 6
DI2
X1
7
8
9
DO1
10
11
DO2
12
13
DO3
14
15
DO4
16
17
DO5
18
19
DO6
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Rx 2
Tx 3
0V 5
Port1
RS232
Front
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(−)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232
A
B
C

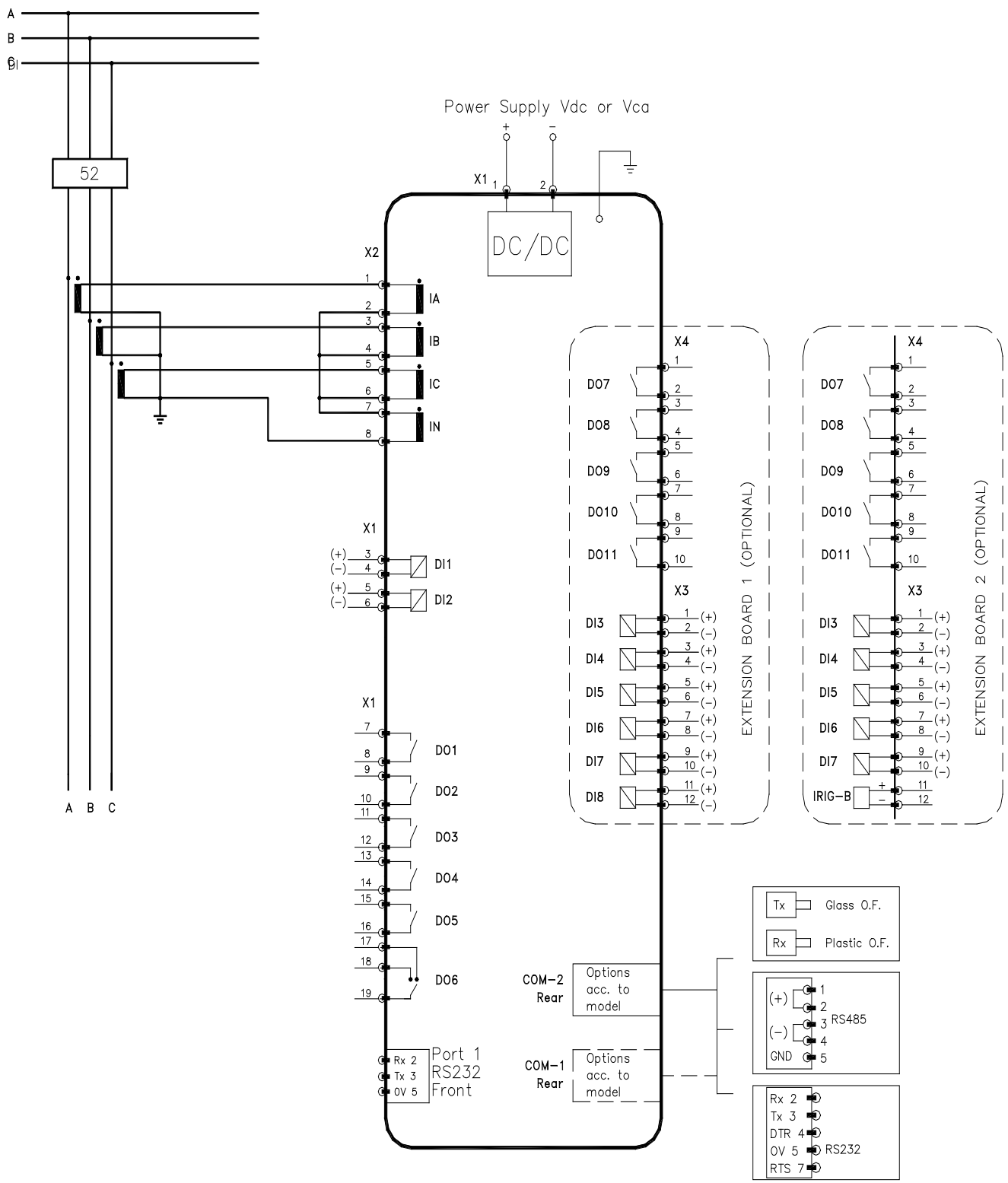
IM Family


A
B
C
52
Power Supply Vdc or Vca
X1
DC/DC
X2
I
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Tx
O.F. glass
Rx
O.F. plastic
COM-2
Rear
Opciones
según
modelo
(+)
(-)
RS485
GND
COM-1
Rear
Opciones
según
modelo
Rx 2
Tx 3
DTR 4
OV 5
RTS 7
RS232
Rx 2
Tx 3
0V 5
Port 1
Front
RS232
A B C

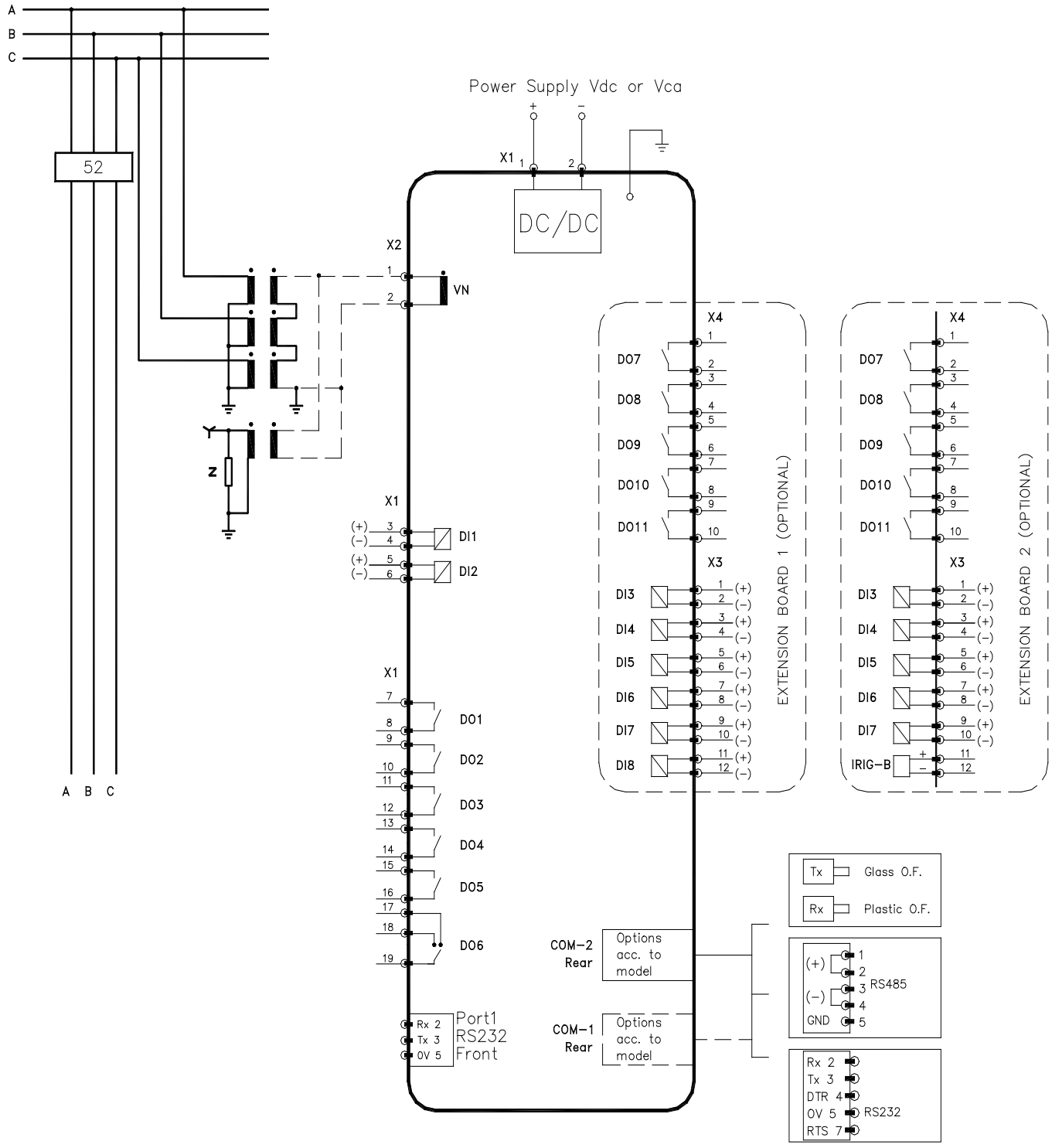
RT Family


A
B
C
52
TRANSFORMER
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
I
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Port1
RS232
Front
Rx 2
Tx 3
0V 5
COM-2
Trasero
Options
acc. to
model
COM-1
Trasero
Options
acc. to
model
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

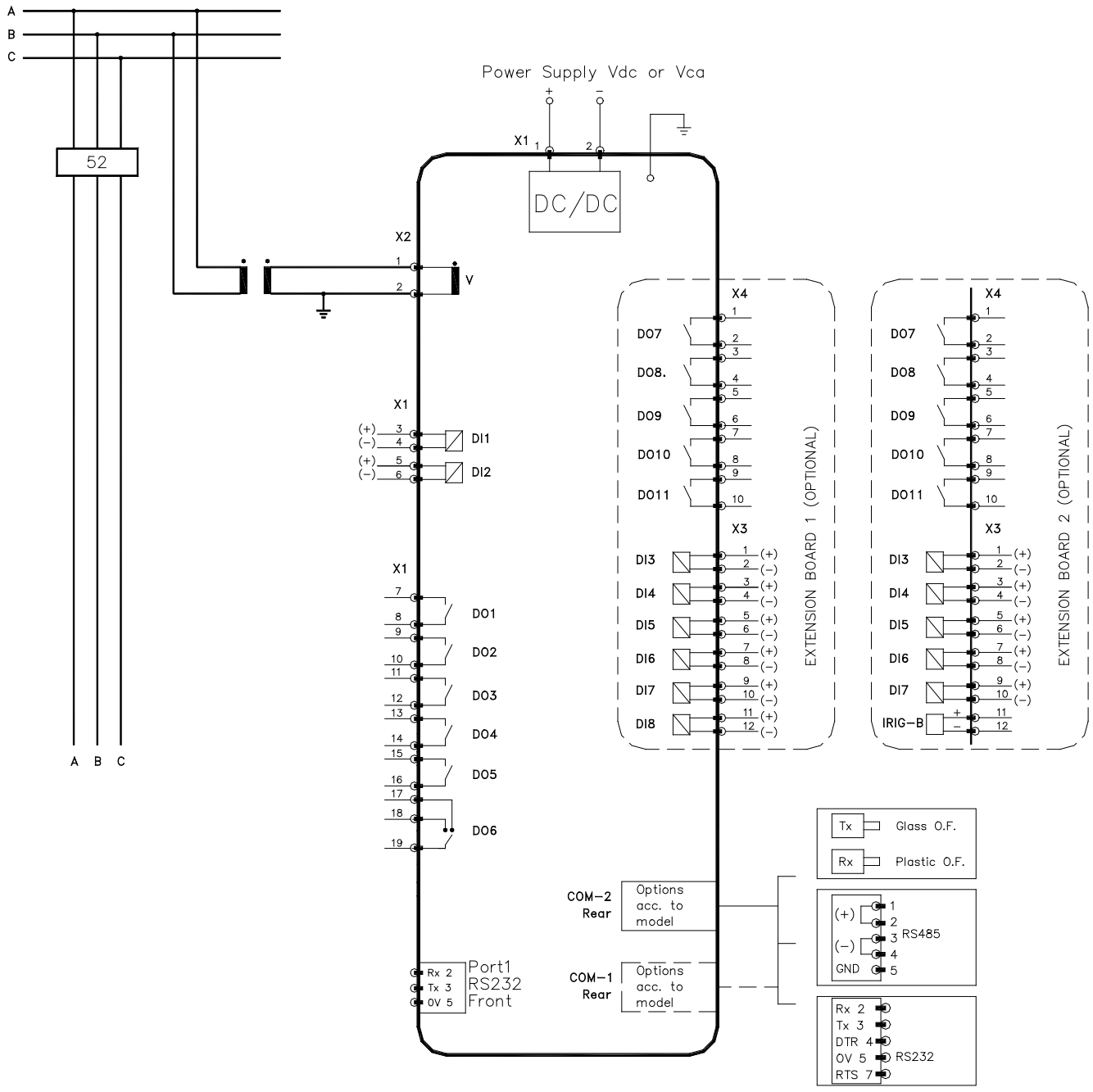
FI Family


A
B
C
52
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
IA
IB
IC
IN
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port 1
RS232
Front
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

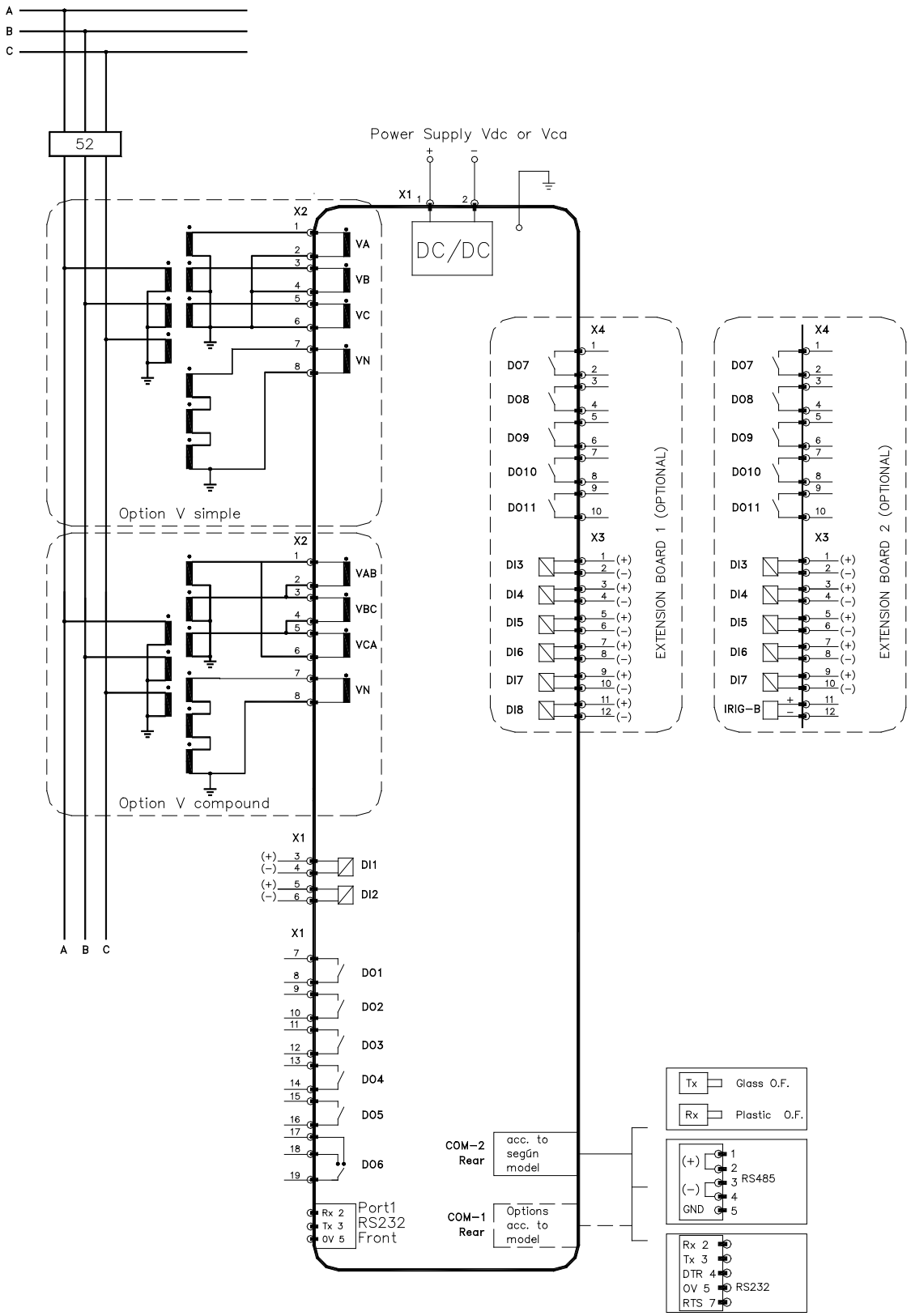
TH Family


A
B
C
52
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
VN
Y
Z
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port1
RS232
Front
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

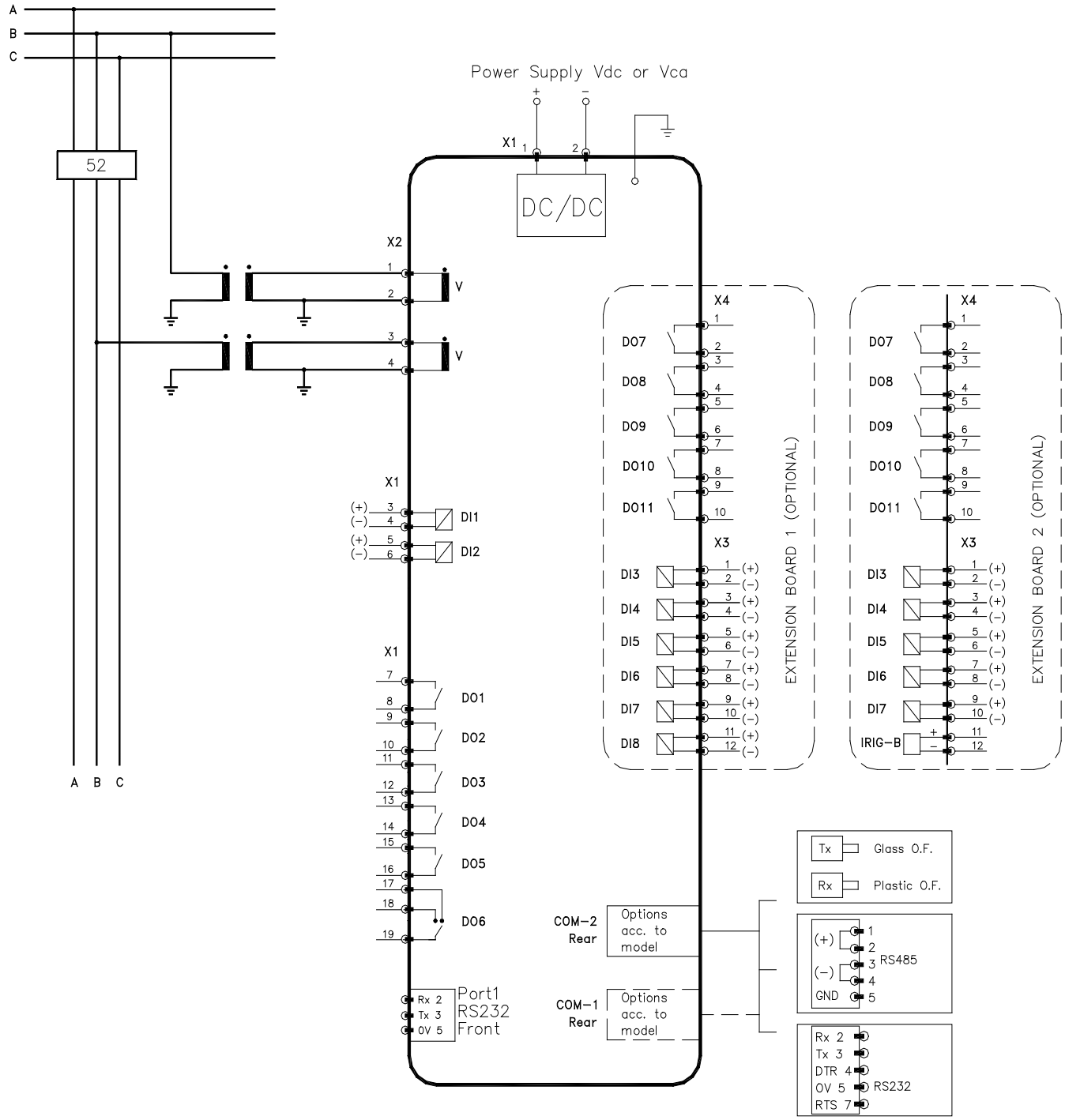
TF Family


A
B
C
52
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
V
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
X4
DO7
DO8.
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Tx
Glass O.F.
Rx
Plastic O.F.
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
(+)
(-)
RS485
GND
Rx 2
Tx 3
0V 5
Port1
RS232
Front
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

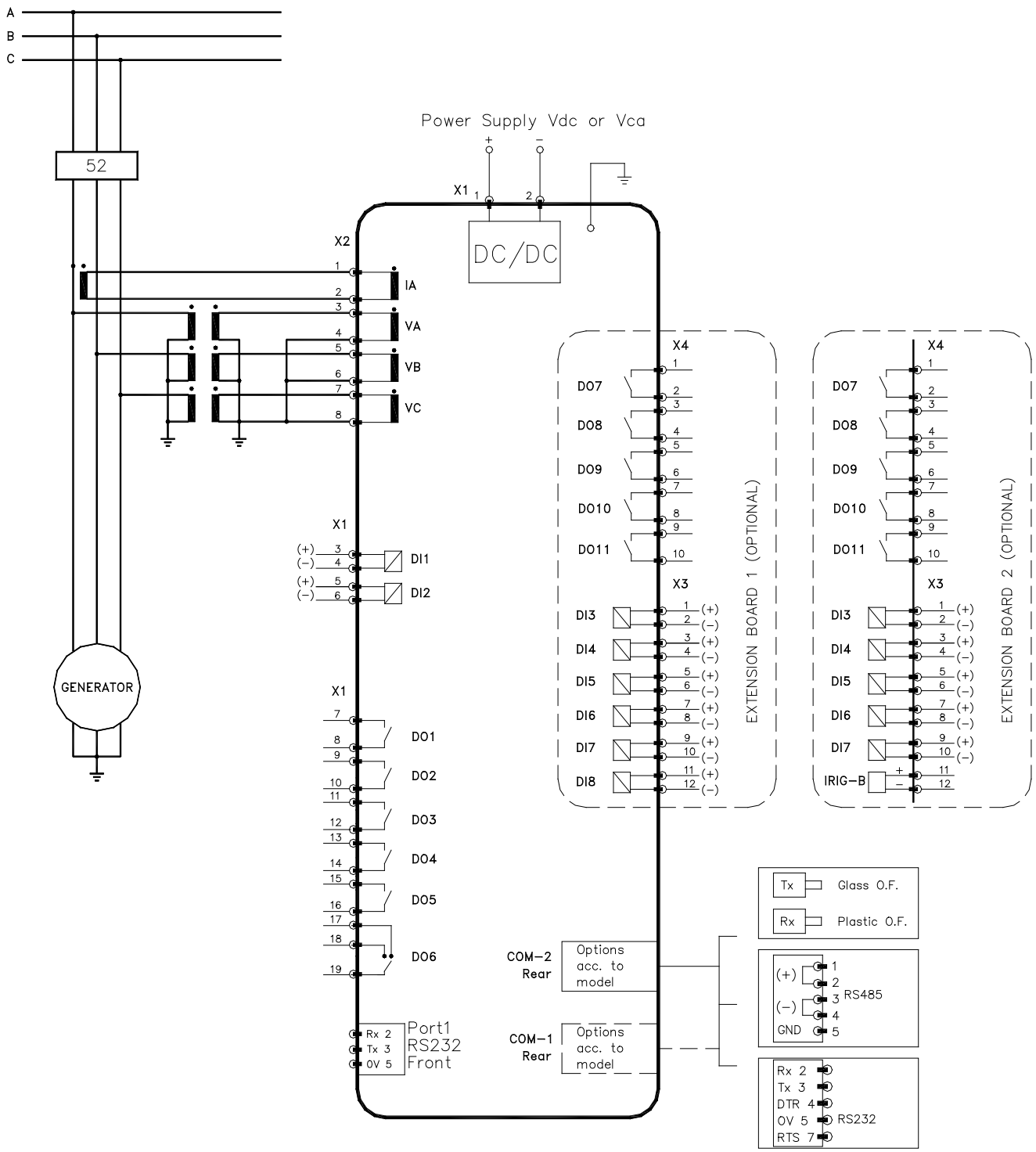
TT and SV Families



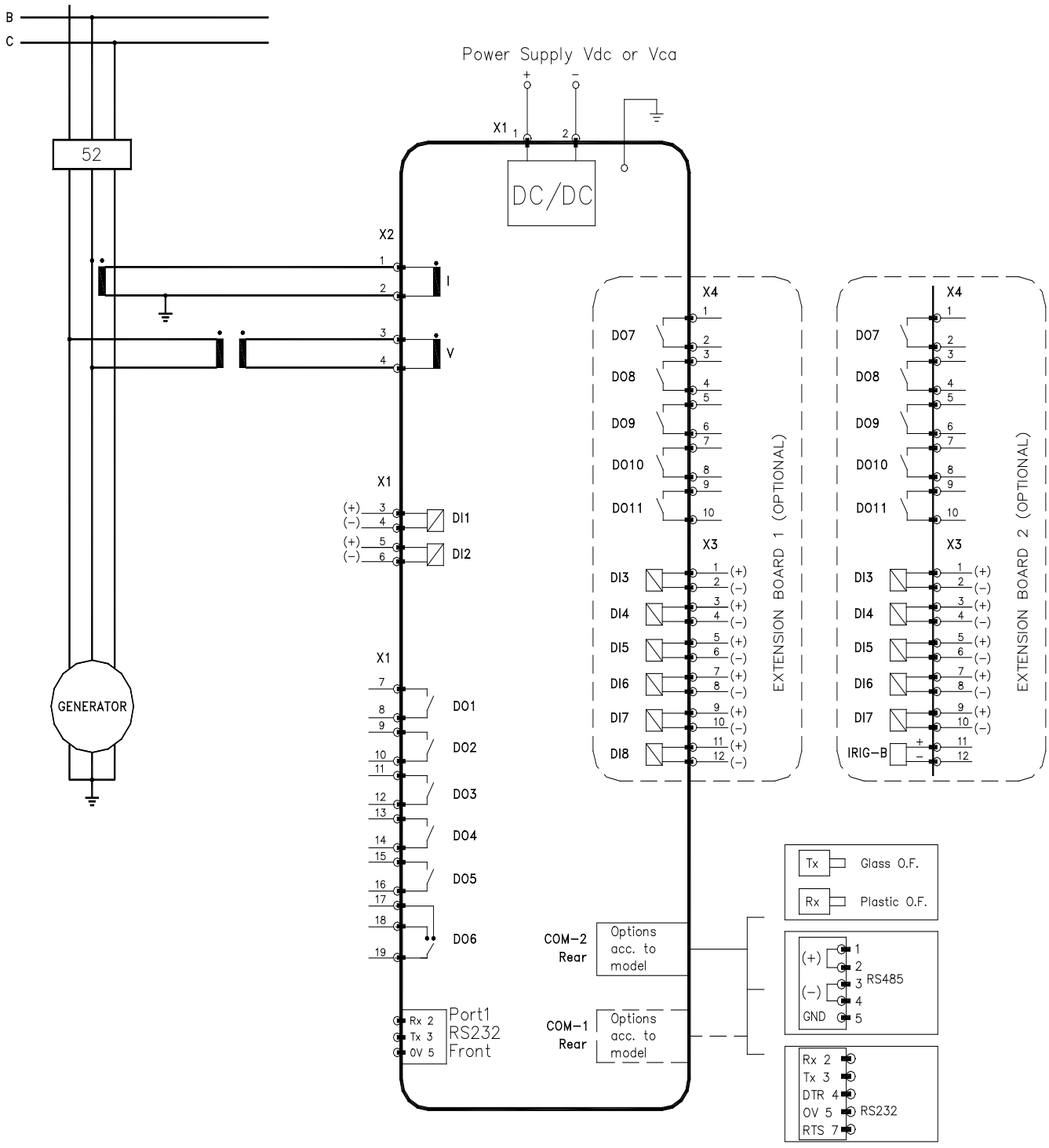
SY Family


A
B
C
52
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
V
V
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port1
RS232
Front
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

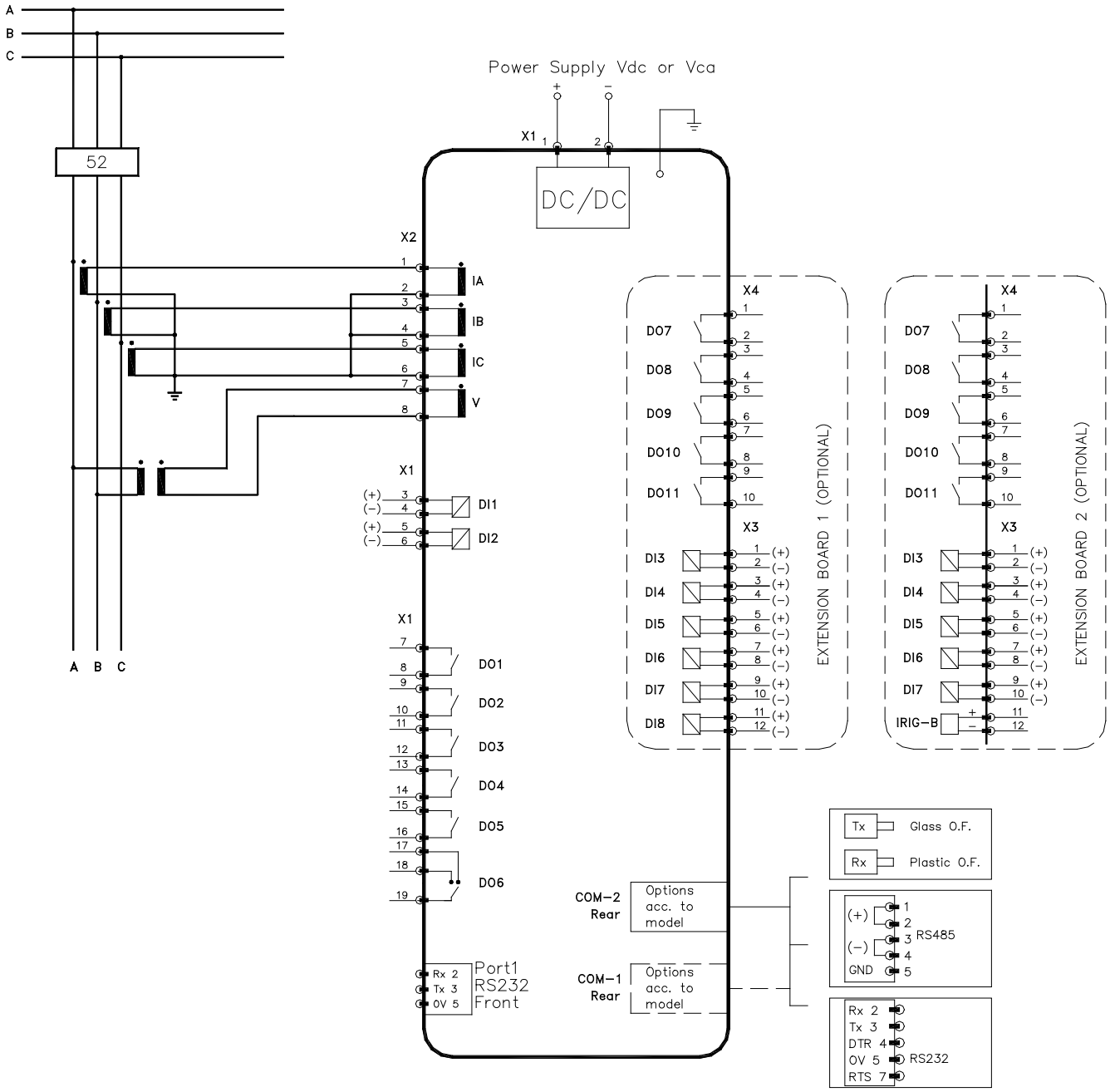
PC Family


A
B
C
52
GENERATOR
Power Supply Vdc or Vca
X1
DC/DC
X2
IA
VA
VB
VC
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port1
RS232
Front
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

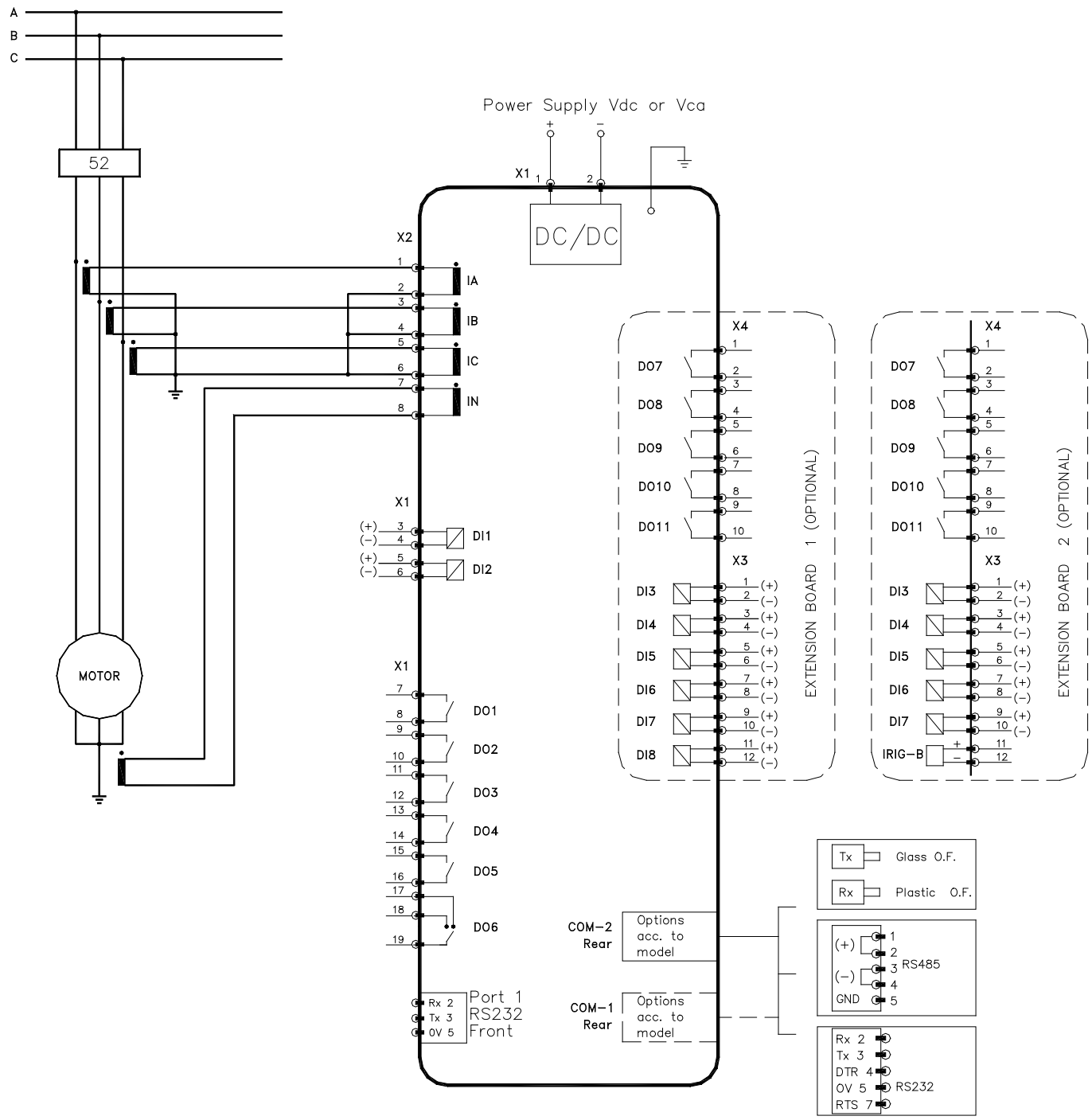
PO Family


B
C
52
GENERATOR
Power Supply Vdc or Vca
X1
DC/DC
X2
I
V
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Port1
RS232
Front
Rx 2
Tx 3
0V 5
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

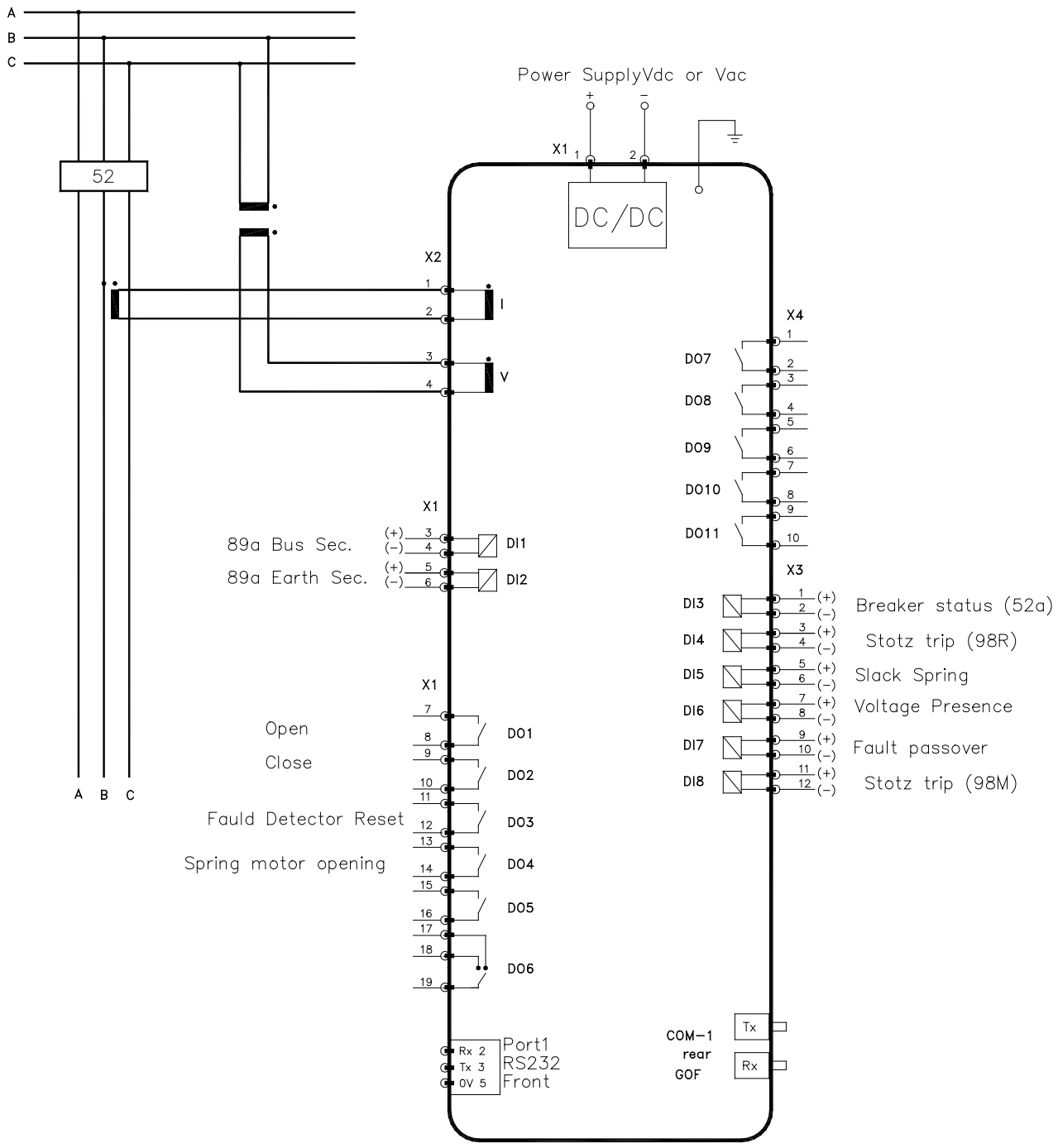
IV Family


A
B
C
52
A B C
Power Supply Vdc or Vca
X1
DC/DC
X2
IA
IB
IC
V
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port1
RS232
Front
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

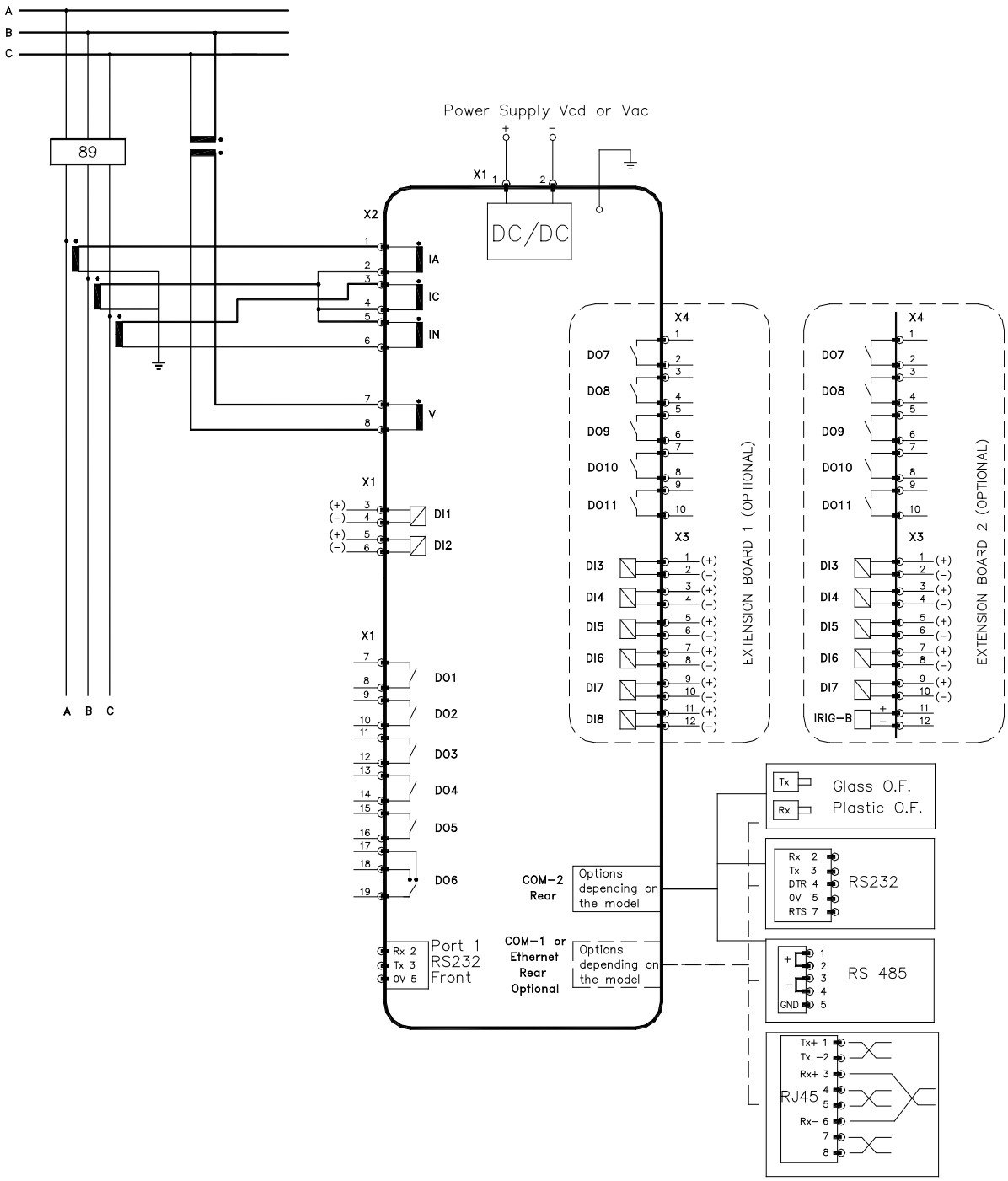
MO Family


A
B
C
52
MOTOR
Power Supply Vdc or Vca
X1
DC/DC
X2
IA
IB
IC
IN
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port 1
RS232
Front
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
COM-2
Rear
Options
acc. to
model
COM-1
Rear
Options
acc. to
model
Tx
Glass O.F.
Rx
Plastic O.F.
(+)
(-)
GND
RS485
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232

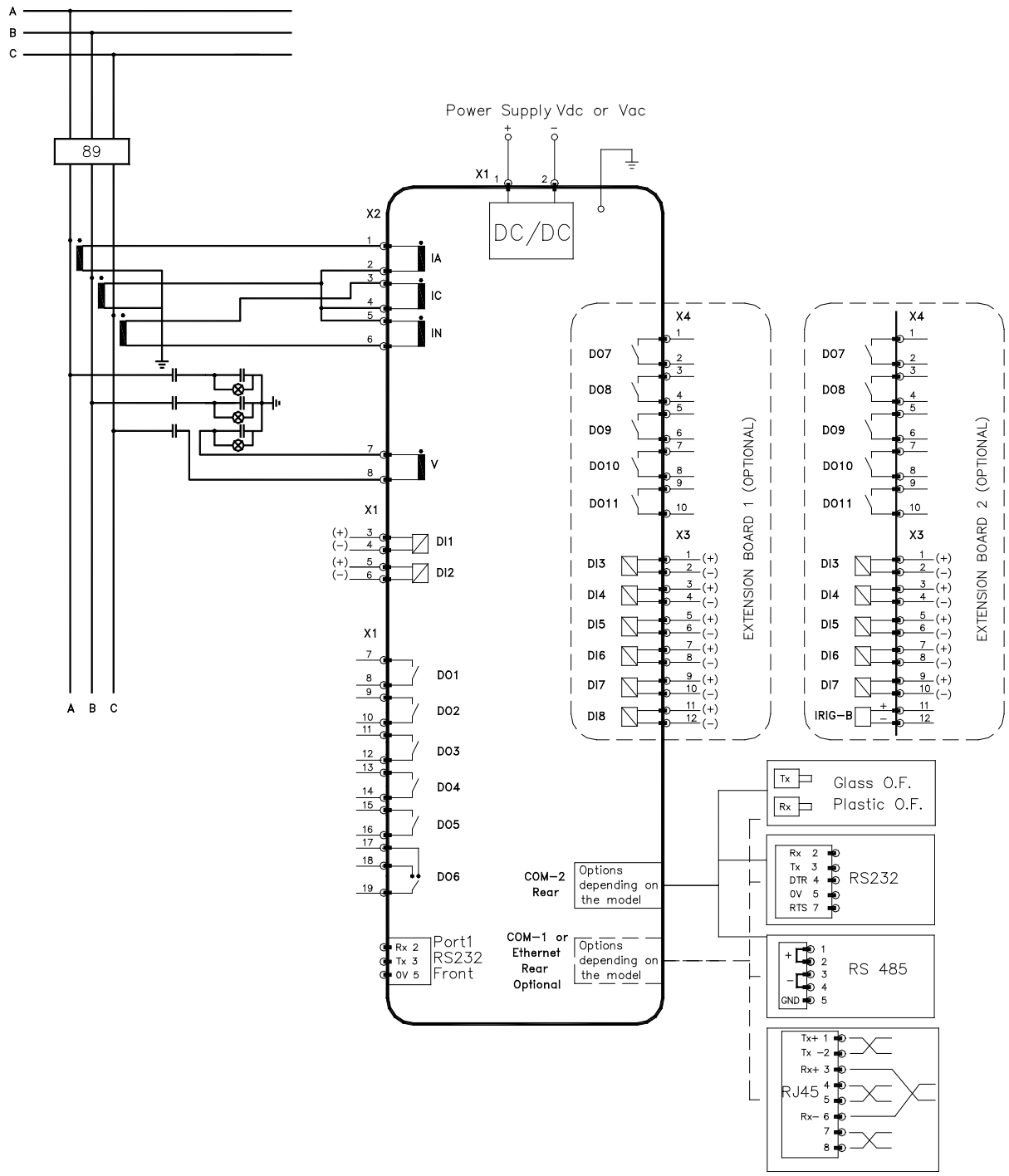
CT Family


A
B
C
52
A B C
Power SupplyVdc or Vac
+
–
X1
1
2
DC/DC
X2
1
2
I
3
4
V
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
Breaker status (52a)
Stotz trip (98R)
Slack Spring
Voltage Presence
Fault passover
Stotz trip (98M)
X1
89a Bus Sec.
89a Earth Sec.
DI1
DI2
X1
Open
Close
Fauld Detector Reset
Spring motor opening
DO1
DO2
DO3
DO4
DO5
DO6
Rx 2
Tx 3
0V 5
Port1
RS232
Front
COM–1
rear
GOF
Tx
Rx

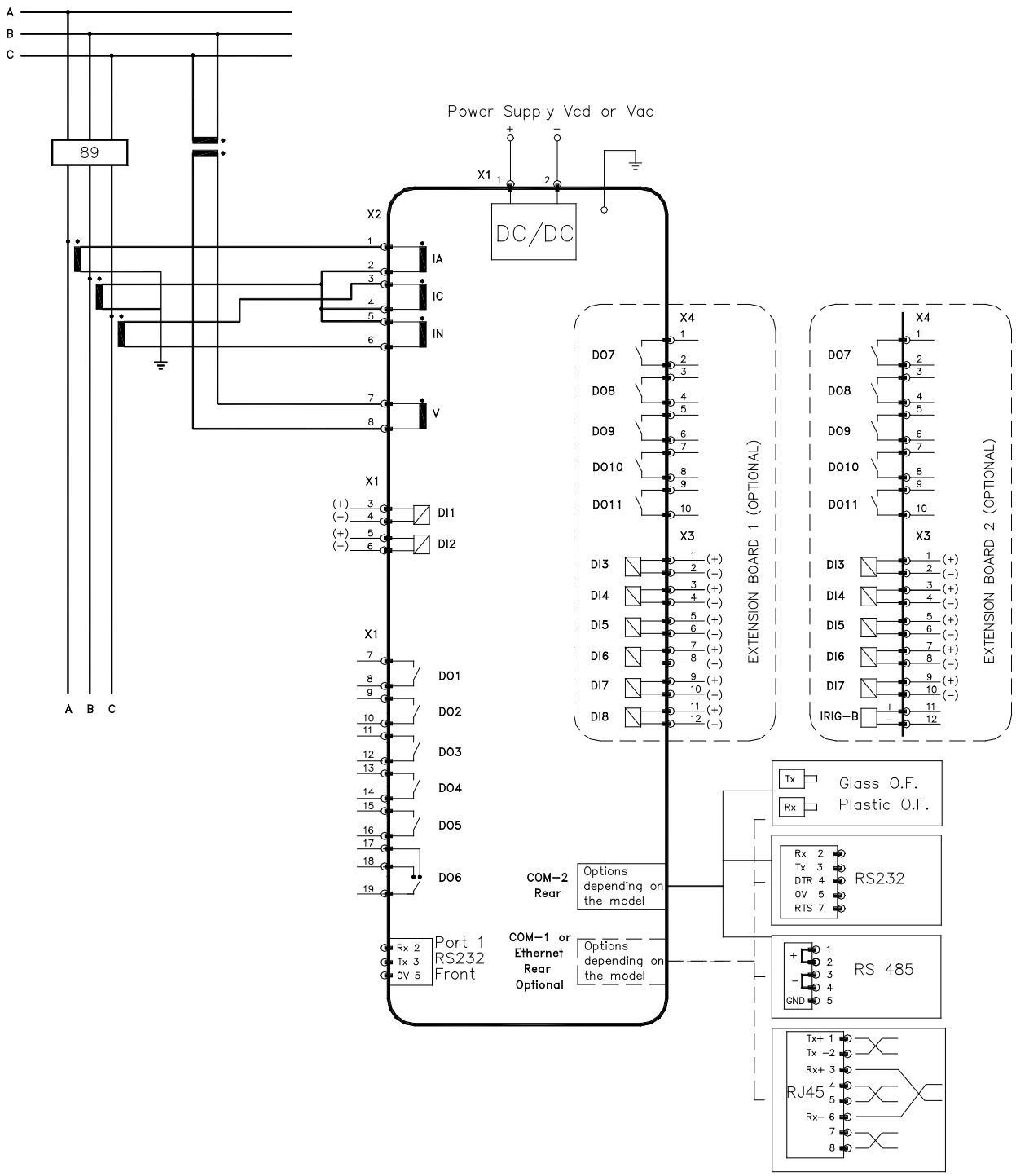
SC family (without input for capacitive splitter)



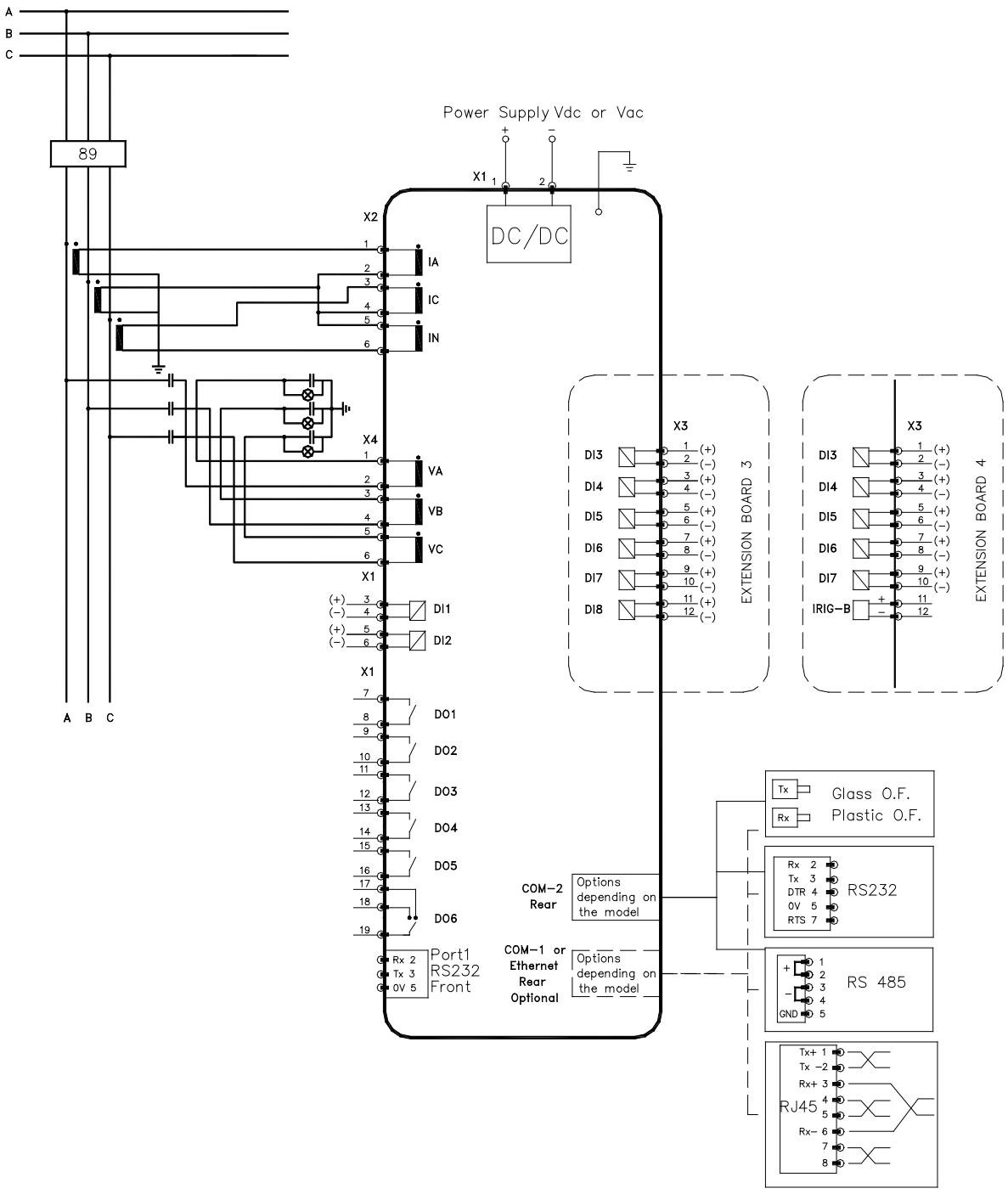
SC family (with input for capacitive splitter)



RC family

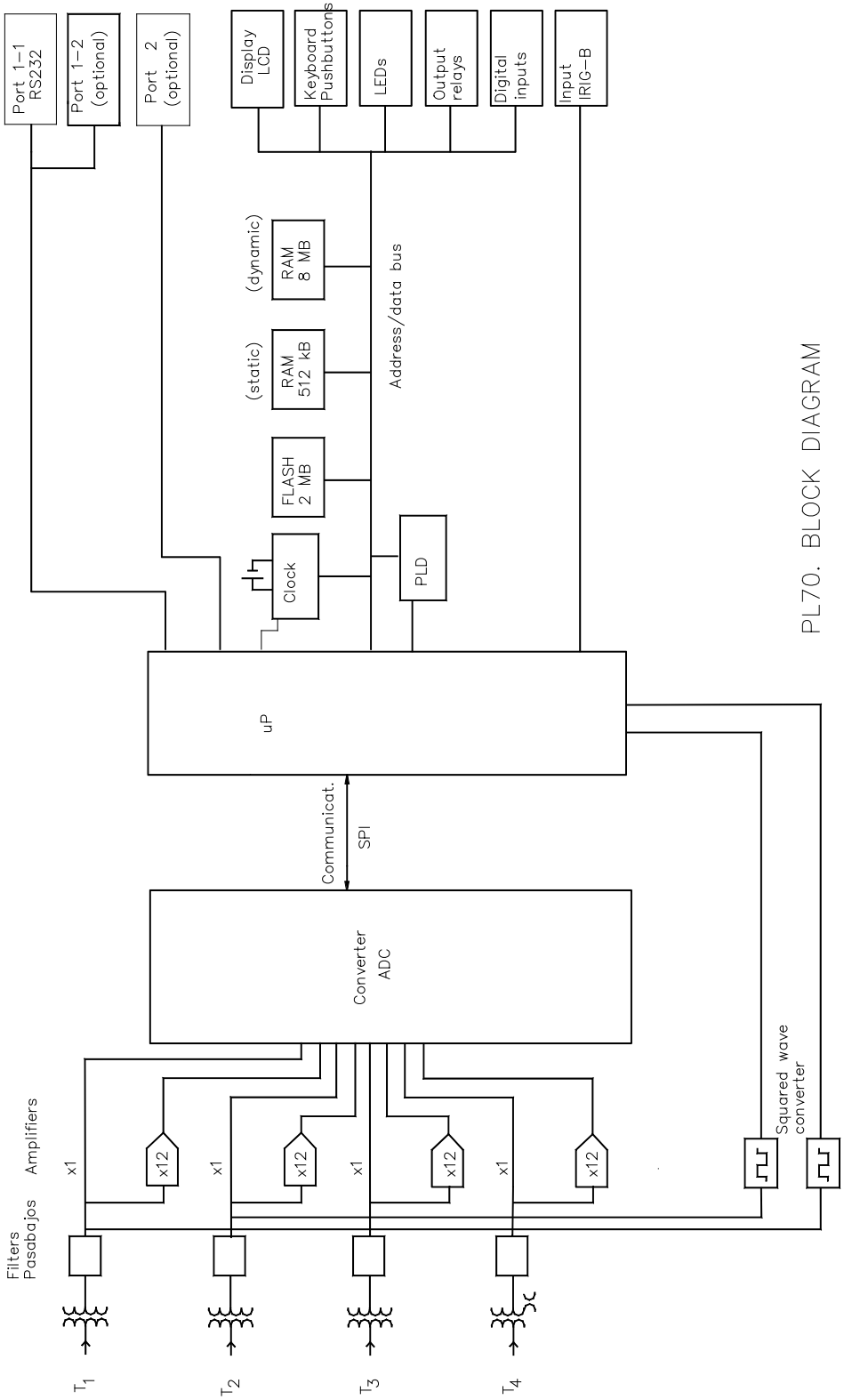

A
B
C
89
A B C
Power Supply Vcd or Vac
X1
DC/DC
X2
IA
IC
IN
V
X1
DI1
DI2
X1
DO1
DO2
DO3
DO4
DO5
DO6
Port 1
RS232
Front
Rx 2
Tx 3
0V 5
COM-2
Rear
Options depending on the model
COM-1 or
Ethernet
Rear
Optional
Options depending on the model
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
DI8
EXTENSION BOARD 1 (OPTIONAL)
X4
DO7
DO8
DO9
DO10
DO11
X3
DI3
DI4
DI5
DI6
DI7
IRIG-B
EXTENSION BOARD 2 (OPTIONAL)
Tx
Rx
Glass O.F.
Plastic O.F.
Rx 2
Tx 3
DTR 4
0V 5
RTS 7
RS232
GND
RS 485
Tx+ 1
Tx -2
Rx+ 3
RJ45
Rx- 6

RS family (with input for capacitive splitter)



The terminal numbers indicated in the previous wiring diagrams is applicable to units both with pin-type terminals and with closed terminals.

Block diagram

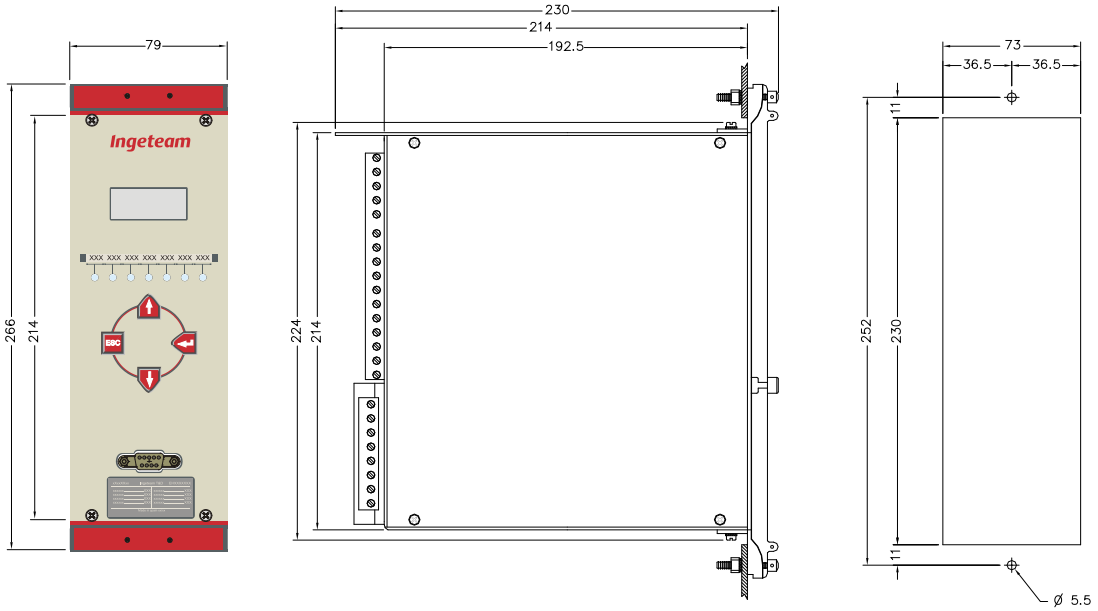


Note: The number of transformers and squared wave generators depends on the family

HARDWARE

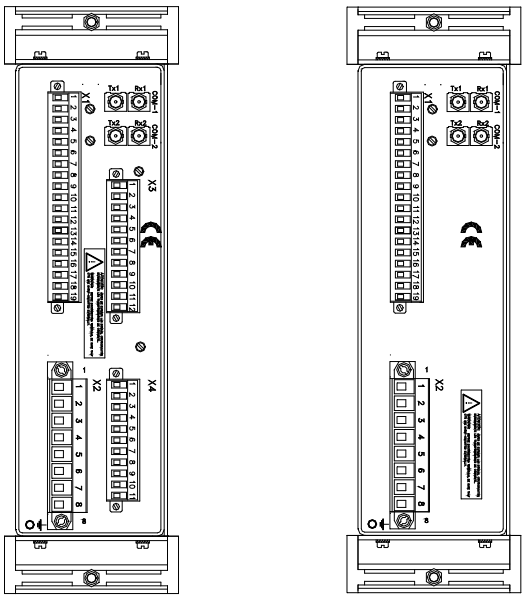
1.10 CONSTRUCTION FEATURES

External dimensions



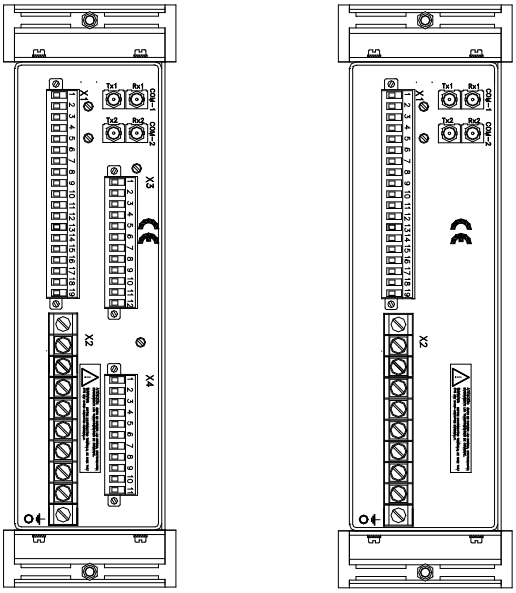
1.11 REAR TERMINALS

Standard (all for pin-type terminals)



With digital I/O extension board *Without digital I/O extension board*

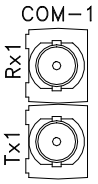
Option with closed-type terminals for analogue inputs



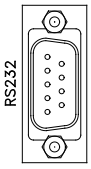
With digital I/O extension board *Without digital I/O extension board*

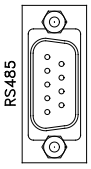
1.12 REAR COMMUNICATIONS PORTS OPTIONS:

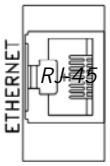
Single output



FO (glass or plastic)

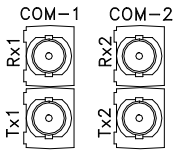






Double output

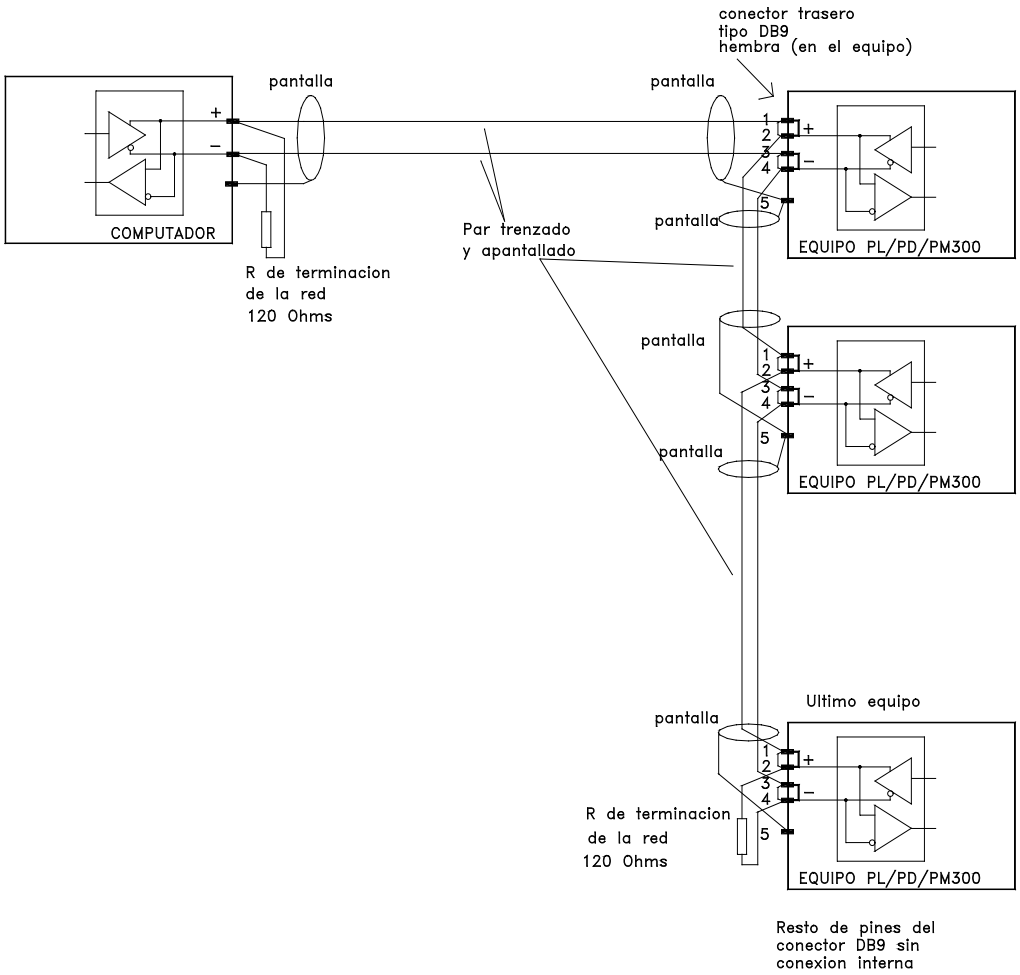
Below there is an example of double port. Any combination is possible, with a sole exception: a COM1 must exist in order for a COM2 to exist.



O

FO + FO

1.13 RS485 CONNECTION BETWEEN VARIOUS UNITS



Although the unit has an internal connection between pins 1 and 2 and between pins 3 and 4, if a connection is made on the bus side, as shown in the figure, a unit can be removed without causing a loss in the chain continuity.

1.14 ETHERNET COMMUNICATION

Ethernet GFO

The characteristics of the optical channels are as follows:

Operating speed:	100Mb
Connector:	ST
Optical transmitter:	LED
Optical receiver:	Photodiode PIN
Optical output:	Without modulation
Working wavelength:	Glass λc = 1300nm
BER	$\delta 10^{-9.}$
Multimode glass fibre optic:	62.5/125μm.

The values contemplate a temperature range of -20ºC to +85ºC.

Loss according to fibre type

	Maximum permitted losses	Losses Km	Losses connection
Glass 62.5/125μm	8 dB	4 dB	0.5 dB

The maximum transmission distance is determined by:

$$-\{\}- l = \frac{PP - PC - ME}{\Delta}$$

PP= Losses permitted in the connection

PC= Losses resulting from insertion of additional connections

ME= Ageing margin. 3 db should be considered

Δ= Cable attenuation in db/Km

Maximum reachable distance:

	In worst conditions	In best conditions
Glass 62.5/125μm	1.25 Km	2 Km

Ethernet via RJ45 cable

600 ohm impedance isolated transformer interface

500 V insulation

RJ45 connector (female)

Baud rate: 10/100 Mbps.

Cable type: Shielded

Cable length: 100 m max.

1.15 TECHNICAL SPECIFICATIONS

Auxiliary power supply voltage

Power supply technical data:

Auxiliary power supply	
220 Vac	
Range	176-264 Vac
Ripple	20 % over the rated current
12 Vdc	
Range	9-17 Vdc
Ripple	20 % over the rated current
24-48 Vdc	
Range	19-58 Vdc
Ripple	20 % over the rated current
125-220 Vdc	
Range	86-280 Vdc
Ripple	20% over the rated current
Burden	
Burden	7W min/ 12W max

The units have been designed to be installed and run in environments equipped with a safe and stable direct current supply. The switched, high-capacity power supplies can be used with alternating current within the following limits:

From 9 to 17 Vdc peak values for the 12 VDC supply, equivalent to an operating range of 7 Vac to 12 Vac RMS approximately.

From 19 to 58 Vdc peak values for the 24-48 VDC supply, equivalent to an operating range of 14 Vac to 41 Vac RMS approximately.

From 18 to 280 Vdc peak values for the 110-125-200 VDC supply, equivalent to an operating range of 70 Vac to 195 Vac RMS approximately.

These units' digital inputs are designed to pick up signals in direct current and within specified ranges

The digital outputs can operate both in DC and in AC power supply systems.

The units have been tested and certified to IEC standards for installation and operation in direct current systems. They have not been tested to AC equipment standards.

Output contacts

Relays 1 to 5:

Carry (permanent) 5 A (at 25 ºC)

Make (0.5 s) 30 A

Breaking capacity (with resistive load)

- at 220 Vdc: 0.4 A
- at 125 Vdc: 1 A
- at 48 Vdc: 3 A

Breaking capacity (L/R=40 ms)

- at 220 Vdc: 0.2 A
- at 125 Vdc: 0.5 A
- at 48 Vdc: 0.5 A

Relays 6 to 11:

Carry (permanent)	5 A (at 25ºC)
Make (0.5 s)	30 A
Breaking capacity (with resistive load)	
at 220 Vdc:	0.15 A
at 125 Vdc:	0.4 A
at 48 Vdc:	2 A
Breaking capacity (L/R=40 ms)	
at 125 Vdc:	0.3 A
at 48 Vdc:	0.5 A

Optoisolated digital inputs

Extended range:

High:	operating range 86 to 280 Vdc (inactive below 60 Vdc)
Low:	operating range 20 to 160 Vdc (inactive below 13 Vdc)
Burden:	< 3 mA

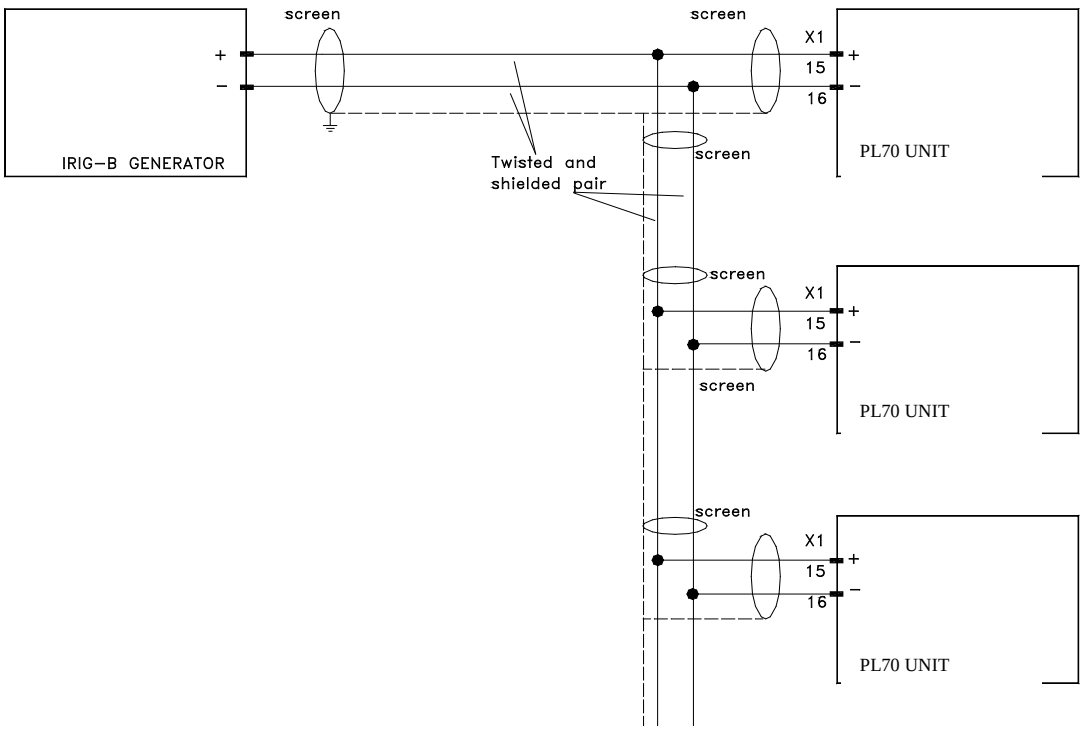
IRIG-B input

Demodulated input, TTL level

Cable type: 2 shielded, twisted wires

Insulation: 500 V

Connections:



The input circuit is a 390 ohm serial resistance with an opto-isolator; for a 5 V signal, the approximate burden is 10 mA.

The number of units that can be connected in parallel to a generator depends on the output current supply capacity; a typical value is 70 mA, which would enable the connection of 6 units (although the length and the type of cable can also influence). The cable must be shielded and twisted.

Phase and neutral current circuits (single rated current 1/5 A)

Thermal capacity		
	Permanent	20 A
	Short time	500 A (1 sec.)
	Very short time	1250 A (half-cycle)
Burden at In= 5 A		<0.2VA
Burden at In= 1 A		<0.02VA

Sensitive neutral or isolated neutral current circuits (single rated current 0.25/0.025 A)

Thermal capacity		
	Permanent	20 A
	Short time	100 A (1 sec.)
Burden at In= 0.25 A		0.0010VA

Current circuit for power protection units

Thermal capacity		
	Permanent	20 A
	Short time	100 A (1 sec.)
Burden at In= 0.25 A		0.0010VA

Voltage circuits

Thermal capacity		
	Permanent	260 V
	Short time	5 Un (1 sec.)
		3.5 Un (1 min.)
Burden at 63.5 V		0.015 VA
Burden at 100 V		<0.03 VA
Bushing insulator voltage circuit		
	Measurement range	0-230mVac

1.16 OPERATING FREQUENCY

Rated: 50 or 60 Hz (programmable)

Operating range: fn ± 5 Hz

1.17 PHASE SUCCESSION ORDER

ABC or CBA (programmable)

UNIT CONFIGURATION

The settings defined below are used for configuring the unit and are, therefore, basic.

Some are only accessible by keyboard/display, whilst others are also accessible by Console.

All are single table settings (Table 0). The ↑↑↓↓ key on the keyboard/display is used to access the table 0 programming via the "Change settings" menu.

1.18 PROGRAMMING DIGITAL AND LOGICAL INPUTS

Two types of inputs are considered in the unit: digital inputs (physical, cabled in the field) and logical inputs (internal). Each possible input function (for example, "breaker status") must only be programmed as either digital or as logical, but not as both.

Digital inputs are programmed as follows:

Via the Console, the programming is effected in the upper of the two boxes found on the right hand side of the "Digital Input Configuration" screen.

By keyboard/display: PROG. TABLE 0 - PROG.CONFIG – CONFIG. INPUTS

SELECT. NO/NC

INPUT ACTIV.T.

CONFIG INPUTS allows a digital input to be programmed from among the following possibilities:

Breaker status

Reference voltage (for the recloser)

External protection action. It causes reclosure (depending on the enabled settings)

Closure command. Activates the closure relay

Breaking command. Activates the general trip relay

Instantaneous inhibition. When active, the instantaneous overcurrent and surge settings do not trip; they register the time passed since their pick up and thus, if they are active when the input is deactivated and the additional programmed time has elapsed, they trip instantaneously.

Activation of table 1. If a pulse is received, the settings table 1 is enabled as an active table.

Activation of table 2. If a pulse is received, the settings table 2 is enabled as an active table.

Activation of table 3. If a pulse is received, the settings table 3 is enabled as an active table.

Activation of table 4. If a pulse is received, the settings table 4 is enabled as an active table.

Relay lock. It sets the relay out of service. It is activated by levels

Selection of Local/Remote command

Monitoring of closure circuit 1 with 52 open (only units with digital I/O extension board)

Monitoring of closure circuit 1 with 52 closed (only units with digital I/O extension board)

Monitoring of trip circuit 1 with 52 open (only units with digital I/O extension board)

Monitoring of trip circuit 1 with 52 closed (only units with digital I/O extension board)

Local drop off. Switches off the trip LEDs and deactivates the relays programmed as "Memorized"; it is equivalent to a keyboard/display fault recognition.

Thermal image drop off. Sets the thermal image metering to zero.

df/dt breaker (level 1)

df/dt breaker (level 2)

df/dt breaker (level 3)

df/dt breaker (level 4)

The above-mentioned inputs can be used for sealing the frequency rate of change trip outputs (TF, TT and SV families).

Pole A status(contact 52a)

Pole B status(contact 52a)

Pole C status(contact 52a)

External trip (three-phase)

External trip phase A

External trip phase B

External trip phase C

The above-mentioned inputs indicate the system state and they are used in the FI family.

Voltage presence. When programmed, the fault passover detection automatism obeys this input instead of the analogue input in order to check the presence of voltage.

Input rearm. When this input is activated, the fault passover detection and the fault signalling outputs, as well as the associated LEDs, are deactivated.

Unallocated. The input can be used by the protection for lockout or logical or may remain unused. In all cases, its status can be transmitted to control.

Do not programme more than one input for each specific function.

SELECT. NO/NC. This defines whether the input must be interpreted as active when it is viewed closed or when it is viewed open. Independently of the selected NO/NC option, the digital inputs programmed in outputs, logics, LEDs and status signals are shown at “one” when there is voltage in the input and at “zero” when there is no voltage in the input.

For example, if we use a contact 52a for the status of the circuit breaker, we must program the corresponding input as NA (when closed it will indicate a closed circuit breaker), while if we use a 52b we must program it as NC (when opened it will indicate a closed circuit breaker).

INPUT ACTIV.T. (input activation time). This is a software filter for the activation / deactivation of digital inputs. The HW filter, which is 1 ms, may be extended via software by the number of programmed milliseconds (range 0 to 20 ms).

Logical inputs are programmed as follows:

Via the Console, the programming is effected in the lower of the two boxes found on the right hand side of the "Digital Input Configuration" screen.

A logical input is a virtual (non-physical) input, the status of which depends on the corresponding logical signal (input 1 corresponds to signal 1, input 10 corresponds to signal 10). The input’s function is as programmed (the programming possibilities are the same as those of the digital inputs).

This procedure allows the assignment of the relay’s internal signals to these inputs as if they were cabled field signals. Up to 10 logical inputs are allowed (given that there are 10 logical signals).

NO/NC selection, the input is active when the logic is active or inactive.

Delay is not applied to the activation.

Example: if we programme logical input 3 as "breaker status" and N/O, the unit will consider the breaker closed when logical signal 3 is active.

Any given function must only be programmed as one input. For example, the programming of "breaker status" as a digital input and as a logical input is not admitted.

1.19 PROGRAMMING OF DIGITAL OUTPUTS

Via the Console, digital inputs are programmed in “Digital output configuration” screen.

By keyboard/display: PROG. TABLE 0 - PROG.CONFIG – PROG. OUTPUTS

INPUT ACTIV. T.

The functionality of each digital output can be programmed as an OR of the logical signals available in the unit (see “List of available signals”, Appendix III).

When programming through Console (recommended), click on the boxes corresponding to the signs for which the OR option is to be activated by the output (dot-matrix programming).

A row titled “OUTPUT TYPE, located at the beginning of the list of available signals in the programming screen, allows the definition of each output “Trip”, “Closure”, “Memorized” or “Nothing”. If the output is set as “Trip”, it implements the sealing logic (when the Sealing setting is set to YES) and the breaker fault logic. If the output is set as “Closure”, it implements the sealing logic (when the Sealing setting is set to YES) and the closure fault logic. If set to “Memorized”, it is deactivated by means of a digital input programmed as “Local drop off”, a command or by the keyboard/display (“Recognise FAULT”). When set to “Nothing”, it performs no special function.

The output activation time defines the minimum operational time of each physical output following activation (in seconds). The range is 0.05 to 5 sec. This appears in the last row on the screen.

The process is a little more complicated by keyboard / display. In PROG.OUTPUT we can define “ASIGN SIGNALS” for each, with the following possibilities:

NO SIGNAL (the output remains unallocated, although it can be activated by control commands).

SAME SIGNALS (the current programming is to be kept).

OTHER SIGNALS (the current programming is to be changed). Using “↵” (Intro), the user can scroll through the logical signals using the arrow ↓; when we arrive at a signal that we want to use in the OR that defines the output, press “↵”; the unit will the ask if we want “MORE SIGNALS?”. If YES, we continue to add signal until we answer NO to this last question.

1.20 PROGRAMMING OF LEDS

Through the Console, the LEDs are programmed in the “LEDs configuration” screen.

By keyboard/display: PROG. TABLE 0 - PROG.CONFIG – PROG. LEDs

The proceedings are fully analogous those of digital output programming, except that the activation time is not programmed and that the possible types are “Memorized” and “Non memorized”. LEDS programmed as “Not Memorized” switch off when the cause which provoked their activation disappears. In order to switch off the Memorized LEDs, "Fault recognition" must be activated by keyboard/display, digital input or command.

1.21 PROGRAMMING OF GENERAL SETTINGS

General description

Event mask

The “Events report” section contains a list of the protection-related events. Most of them can be masked from the PC. They can not be masked from the keyboard.

In order for an event type to be registered, the mask must be set to “NO”.

Transformation ratios:

only used by the protection to provide measurements related to the primary.

Rated voltage

the rated phase to earth voltage. It is used by the protection to provide measurements in Procome format (the scale range of the voltage measurements is 1.2 times the rated voltage).

In PL70SC and RS bushing insulator models (with capacitive splitter input), the rated voltage, which is to be found in the “Programmable factors and bushing insulators" screen, is programmed in kV.

Voltage type

This indicates if the voltage signals connected to the unit are “simple” (phase-earth) or “compound” (phase-phase).

Voltage metering

This indicates the phases in which the voltage is metered.

In the Console, these settings are located in the “General settings and remote port configuration” screen, and in the keyboard/display in “PROG.TABLE 0” – “GENERAL” (through the keyboard, the voltage Type and Measurement settings are both found under the common heading “Voltage input”).

Language

English or Spanish. This refers to the text which appears in the display.

In the Console, this setting is located in the "General Settings" screen, and in "PROG.TABLE 0" - "General" - "LANGUAGE" via the keyboard/display.

Rated current

This setting is used to set the necessary “In” rated voltage for the motor protection units.

Stabilization time unknown52

Transition timing for breaker inputs. This setting consists of the non-activation of the “Unknown 52" signal as a result of discordance in the digital inputs until the adjusted time has elapsed.

Programmable phase current metering scale range

This setting consists of the inclusion of a programmable phase current metering scale range. Thus, the metering scale range is not limited to 0.3A, and can be set between 0.1-3A.

This setting, which is only used in the SC, RC and RS families, is located in the Protection Console in the “General Settings" screen, and via the keyboard / display in "PROG.TABLE 0" - "GENERAL" - "PHASE CURR.”.

Programmable neutral current metering scale range

This setting allows the programming of a neutral metering scale range 0.1-3A for models A and B, or between 0.1-2A for models C and D, independently of the phase metering scale range.

This setting, which is only used in the SC, RC and RS families, is located in the Protection Console in the “General Settings" screen, and via the keyboard / display in "PROG.TABLE 0" - "GENERAL" - "NEUTR. CURR.”.

Fault reporting

This setting allows the user to choose whether the fault report is generated in primary or in secondary values. In the Console, this setting is located in the "General Settings" screen, and in "PROG.TABLE 0" - "GENERAL" - "FAULT REPORTS" via the keyboard/display.

Settings ranges (table 0, single)

Setting	Minimum	Maximum	Step	Remarks
Event mask				See “Events"
. Transformer I phase ratio	1	3.000	1	
. Transformer I neutral ratio	1	3.000	1	Families with Neutral transformer
. Transformer I sensitive neutral ratio	1	3.000	1	Families with Sensitive Neutral transformer
. Voltage transformer	1	9.999	1	
Simple rated voltage (V)	23,0 40,0 40,0	115,5 270,0 200,0	0,1 0,1 0,1	IV family SC and RC families (models A and C) Other families
Voltage type				Phase to earth/Phase to phase
Voltage metering				Phases in which metering is effected
Language				English/Spanish
Rated current	1.0	10.0	1.0	
Unknown signal stabilization time 52 (sec.)	0	60	1	SC, RC and RS families
Phase current metering scale range	0,1	3,0	0,01	SC, RC and RS families
Neutral current metering scale range	0,1 0,1	3,0 2,0	0,01 0,01	SC family (models A and B) / RC family (model A) SC family (models C and D) / RC family (model C) / RS family
Fault reporting				PRIMARY/SECONDARY

1.22 COMMUNICATION CONFIGURATIONS

Carried out via the keyboard/display or the Protections Console.

Communication via front port (Port 1_1) and rear port no. 2 (Port 1_2)

The PL70 unit has an address identifying number which enables it to identify the messages received from the PC via its front port (or via its rear port in parallel) using the protocol PROCOME. This address is programmable from the keyboard/display, via “CHANGE SETTINGS”, “PROG. TABLE 0”, “CONFIG.COMMUNIC.”, “FRONT PORT”, “UCL ADDRESS", or via the "PROCOME SETTINGS", "PROCOME General" screen in the Protections Console.

The factory setting for the address is 4, which is used the Engineering programme when defining the installation.

If this number in changed in Engineering for any reason, the address programming must also be changed, and vice-versa.

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate, parity and the number of STOP bits are also programmable within COMUNICAC. CONFIG”. The units are supplied with 19200 baud rate, even parity and 1 STOP bit factory settings.

The established communications settings can be seen in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, “CONFIG. COMMUNIC.”.

In addition to the keyboard/display, the settings can be viewed/programmed from a PC using the Protections Console.

Baud rates of 115200 bauds or higher are only employed for downloading firmware and not used in normal operation.

Communication via rear port nº 1 (Port 2)

The protocol type to be used by this port is defined in “CHANGE SETTINGS”, “PROG. TABLE 0”, “COMMUNIC. CONFIG.”, “SELECT COMM. T.”, or from the "GENERAL SETTINGS", "General configuration" screen in the Protections Console. The options are: Procome, DNP3.0, MODBUS and 103 for all the families, with the exception of the SC, RC, RS and CT families, which use: Procome, Gestel, PID1, SAP20, IEC-101 and DNP3.0 (see the corresponding appendix).

Procome:

If Procome is chosen, in “CHANGE SETTINGS”, “PROG. TABLE 0”, “CONFIG.COMMUNIC.”, “REAR PORT”, a settings group which is analogous to the group defining the front port (it is not necessary for the groups to share the same values) is programmed. There is an additional “CONTROL SIGNALS” setting, which provides the options “None” and “RTS”.

DNP:

If the option chosen is DNP, the address is programmable from the keyboard/display, entering “SETTINGS (change)”, “PROG. TABLE 0”, “REAR PORT”, "MODBUS CONFIG.", "UCL ADDRESS". . This address does not need to be the same as the front port address, although it is convenient in order to avoid confusions. The units leave the factory with unprogrammed addresses and DNP parameters. **These parameters must be programmed by the user.**
If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The unit also has an identification number relative to the Master unit to which is connected, and only accepts messages originated from this unit. This is also programmable in the unit, within the “CONFIG. DNP”. The address' factory setting is 0. The baud rate, parity and the number of STOP bits are also programmable. The units are supplied with 9600 baud rate, no parity and 1 STOP bit factory settings.

The established communications settings can be viewed in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, "REAR PORT”, “GESTEL CONFIG.” DNP”.

For further information about DNP communication, see the corresponding Appendix.

MODBUS:

If the MODBUS option is selected, the address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “REAR PORT”, "MODBUS CONFIG.", "UCL ADDRESS". . This address does not need to be the same as the front port address, although it is convenient in order to avoid confusions. The units leave the factory with unprogrammed addresses and MODBUS parameters. **These parameters must be programmed by the user.**

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate, the parity and the auxiliary waiting time for the activation and deactivation of the RT signal (internal) are also programmable.

The established communications settings can be viewed in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, "REAR PORT”, “MODBUS CONFIG.”.

For further information about MODBUS communication, see the corresponding Appendix.

IEC 870-5-103:

If the 103 option is selected, the address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “COMM. CONFIG.”, “REAR PORT”, “UCL ADDRESS”. . This address does not need to be the same as the front port address, although it is convenient in order to avoid confusions. The units leave the factory with unprogrammed addresses and 103 parameters. **These parameters must be programmed by the user.**

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate, the parity and the auxiliary waiting times for the activation and deactivation of the RTS signal (internal) are also programmable.

The established communications settings can be seen in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, “COMM. CONFIG.” “REAR PORT”.

In addition to the keyboard/display, the settings can be viewed/programmed from a PC using the Protections Console.

For further information about 103 communication, see the corresponding Appendix.

Gestel:

If the Gestel option is selected, the address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “REAR PORT”, "Gestel CONFIG.", "ADDRESS". This address does not need to be the same as the front port address, although it is convenient in order to avoid confusions. The units leave the factory with unprogrammed addresses and Gestel parameters. **These parameters must be programmed by the user.**

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate and the parity are also programmable. The units are supplied with factory settings of 9600 bauds and even parity.

The established communications settings can be viewed in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, "REAR PORT”, “GESTEL CONFIG.” .

For further information about GESTEL communication, see the corresponding Appendix.

PID1:

If the PID1 option is selected, the address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “REAR PORT”, "PID1 CONFIG.", "ADDRESS". The units leave the factory with unprogrammed addresses and PID1 parameters. **These parameters must be programmed by the user.**

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate, the parity and the auxiliary times are also programmable.

The established communications settings can be viewed in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, "REAR PORT”, “PID1 CONFIG.”.

For further information about PID1 communication, see the corresponding Appendix.

SAP20:

If the SAP20 option is selected, the address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “REAR PORT”, "SAP20 CONFIG.", "ADDRESS". The address and the rest of the SAP20 parameters have to be programmed by the user.

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate and the auxiliary times are also programmable.

The established communications settings can be viewed in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, "REAR PORT”, “SAP20 CONFIG.” .

For further information about SAP20 communication, see the corresponding Appendix.

IEC-101:

If the 101 option is selected, the address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “REAR PORT”, "101 CONFIG.", "ADDRESS". The address and the rest of the IEC-101 parameters **have to be programmed by the user.**

If a PL70 unit is substituted by another, the installed unit must be given the same address as the unit that is withdrawn.

The baud rate, the parity and the auxiliary times are also programmable.

The established communications settings can be viewed in the display in “VIEW SETTINGS”, “VIEW TABLE 0”, "REAR PORT”, “101 CONFIG.”.

For further information about 101 communication, see the corresponding Appendix.

Ethernet communication

Only applicable in those models equipped with an Ethernet port.

In order to configure the Ethernet port, the first parameter to be configured corresponds to the selection of the TCP/IP communication. This address is programmable from the keyboard/display, entering “CHANGE SETTINGS”, “PROG. TABLE 0”, “COMMUNIC. CONFIG.”, “TCPIP”, or from the "GENERAL SETTINGS", "TCP/IP protocols configuration" screen in the Protections Console. This parameter’s options are: “No” and “Procome” for all families. SC and CT families have the additional option of IEC-104 (see corresponding appendix). The functioning according to this parameter is as follows:

Procome

The Procome protocol is employed for communications via the Ethernet port. In this case, the selection of the procome protocol in another rear port ("com 2") is not permitted. In summary, the Procome protocol is used to communicate via the Ethernet port, whilst a selected protocol (with the exception of Procome) is used in the second rear port (when available).

IEC-104:

The 104 protocol is used for communications via the Ethernet port. In this case, only the procome protocol can be selected in the other rear port ("com 2").

For further information about 104 communication, see the corresponding Appendix.

1.23 OTHER CONFIGURATION SETTINGS

These settings may be accessed via the keyboard/display or the Protections Console. They are accessed via the Console, through the "General Settings" screen, "Configuration General", and via the keyboard/display through "CHANGE SETTINGS", "PROG. TABLE 0", "SPECIAL SETTINGS".

Accessible via the keyboard/display and the Protections Console

Frequency

50 Hz or **60 Hz**. This is the basic protection setting. If an incorrect setting is chosen, the measurements and, therefore, the protection operation, will also be incorrect.

Phase order

A, B, C or **C, B, A**. This only affects the broken conductor and unbalance (currents and voltages) protection functions. To verify that the order corresponds to the cabling, consult "Measurements" and check that the ratio of the inverse/direct component is close to 0% when introducing 3 balanced currents of around 1 A.

Enabling of pushbuttons

If this setting is set at "YES", the front command pushbuttons are enabled. If it is set at "NO", the front command pushbuttons "disappear" (only available in SC, RC, RS and CT families).

Neutral Voltage

In those models which measure neutral voltage and are equipped with phase voltage transformers, the VN measurement may be calculated or measured through the neutral transformer.

Current phase B

In the IS and IT models, the phase B current in question can calculated (in those cases in which only phases A, C and neutral are cabled) or metered through the phase B transformer.

If the adjustment of current phase B is calculate, the measure B made with the measures of transformers A, C and neutral, regardless of what is injected into the transformer B. If the setting is transformer, the measure of phase B it will be injected into the transformer B.

Accessible only via keyboard/display

Operating mode

This setting only exists for the MO family. There are 2 options: "MOTOR" or "GENERATOR". In "generator" mode, a "picked up unit" detection is not required for the activation of any of the protection functions, which implies the following:

- the undercurrent function must be disabled (in general)
- the "long start" and "starts per hour" functions are not operative
- the "rotor lock" function, if enabled, acts permanently as an overcurrent function.

any outputs programmed as "picked up motor" are always activated.

Calibration

This menu position is to be used exclusively by the Ingeteam Transmission and Distribution SA technicians, according to specific procedures. It must not be used by the user.

Display contrast setting

The procedure is as follows:

By pressing the “ESC” (from the 4 key keyboard) key for 3 to 5 seconds in the initial screen (the screen showing part of the unit’s commercial code), the user enters the contrast setting menu and the following text appears: “Contrast setting. –DOWN + UP”.

The “ ↑ ” and “ ↓ ” keys are used to set the contrast. “ ↑ “ increases and “↓” decreases brightness, respectively.

To validate, press “ESC”, or after 1 minute the screen will return to the normal situation, with the changes realized.

PROTECTION FUNCTIONS DESCRIPTION AND SETTINGS

1.24 PHASE OVERCURRENT PROTECTION

General description

Three-phase overcurrent protection, with the following selectable characteristics (function 50/51):

Timed characteristic

Normal inverse time. (I BSC or I ANSI)

Short inverse time (IL BSC)

Long inverse time (IL BSC)

Very inverse time. (MI BSC or MI ANSI)

Extremely inverse time. (EI BSC or EI ANSI)

Special very inverse time (MIEs BSC)

Moderately inverse time (ANSI)

User curve (USUAR 1)

Definite time

Instantaneous characteristic

Two instantaneous elements (the second is optional)

Additional time

The functioning of this protection is coordinated with the reclosure function (optional).

Timed characteristic settings ranges (4 tables) (normal and HIGH2)

Setting	Min	Max	Step	Remarks
Phase time enabling				YES/NO
Timed phase pick up (A)	0,015 0,003 0,1	3,000 3,000 100,0	0,001 0,001 0,01	RC family (Model A) RC family (Model C) Other families
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,00	600,00	0,01	

The timed normal characteristics settings can be found in the console on the “Overcurrent protection (1)” screen.

The timed HIGH2 characteristics settings can be found in the console on the “Overcurrent Protection (HIGH 2)” screen. To see families who may have timed HIGH2 characteristics (see section “1.2 Functions”).

In units equipped with the 51V option, they can be modified in accordance with the voltage (see “Voltage control”, only available in IV family).

If the Enable setting is set at YES, the function can generate trips. If it is set at NO, the function is not activated. This is general for overcurrent functions.

The start-up current is set in Amperes in the secondary.

In definite time, the relay trips upon the expiry of the programmed time as of the moment in which the start-up current is exceeded, independently of the current value.

When working with curves, the time that passes before the trip depends on the selected curve (family and index) and the current value. The normal, very inverse, extremely inverse and user curves can be selected as corresponding to the BS142 (IEC 255-4) standard or ANSI. Appendix II contains graphics and formulas for the calculation of the time in accordance with the quotient between the current and the pickup current. If the quotient is higher than 40, 40 is taken for the calculation.

The maximum error in times for values higher than 50 ms is 30 ms, or 5% of the theoretical value (the higher of the two). For the programming of 0 ms definite time, the behaviour is the same as that for the instantaneous characteristic (see next point).

Note. If an index value is which is unacceptable for a specific curve type is programmed, the unit uses the closest acceptable value.

Timed phase inhibition setting (4 tables)

This setting is shown on the "TOC Limitations" under the "Phase TOC Limitations" heading, or via the keyboard/display (in PROTEC. FUNCTION., in PHASE TOC. LIMIT.).

The phase timing inhibition setting enables the inhibition of this characteristic as the start-up of the phase instantaneous characteristic.

Instantaneous characteristic settings ranges (low level) (4 tables) (normal and HIGH2)

Setting	Min	Max	Step	Remarks
Instantaneous phase enabling				YES/NO
Instantaneous phase pick up (A)	0,015 0,003 0,1	3,000 3,000 100,0	0,001 0,001 0,01	RC family (Model A) RC family (Model C) Other families
Additional instantaneous time (s)	0,00	60,00	0,01	

The instantaneous normal characteristics settings can be found in the console on the “Overcurrent protection (1)” screen.

The instantaneous HIGH2 characteristics settings can be found in the console on the “Overcurrent Protection (HIGH 2)” screen. To see families who may have timed HIGH2 characteristics (see section “1.2 Functions”).

The trip current is set in Amperes in the secondary.

If the additional time is programmed as 0, for current values between the trip value and 1.5 times this value, the trip occurs between 35 and 45 ms; for values of twice trip current, the trip occurs between 30 and 35ms, and from values of 3 times the trip current, between 20 and 25 ms. Any additional programmed time includes the indicated time. With additional times higher than 50 ms, the maximum error in times is 30 ms or 5% of the theoretical value (the higher of the two).

Instantaneous characteristic setting ranges (high level) (4 tables)

Setting	Min	Max	Step	Remarks
Instantaneous phase enabling				YES/NO
Instantaneous phase pick up (A)	0,1	100,0	0,01	
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in the Console in the “Instantaneous overcurrent protection (HIGH 1)” screen.

The time characteristics are the same as those detailed in the previous section.

1.25 NEUTRAL OVERCURRENT PROTECTION

General description

In neutral earthed installations, this provides neutral overcurrent protection with the same characteristics options as those described for phase overcurrent, as well as independent settings (function 50N/51N).

Timed characteristic settings ranges (4 tables) (normal and HIGH2)

Setting	Minimum	Maximum	Step	Remarks
Neutral timing enabled				YES/NO
Timed neutral pick up (A)	0,02 0,005 0,008 0,002 0,1	20,0 5,000 3,000 2,000 100,0	0,01 0,001 0,001 0,001 0,01	IT / IS family(Models C and D) IS family (Models A and B) RC family (Model A) RC family (Model C) Other families
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,0	600,0	0,1	

The timed normal characteristics settings can be found in the console on the “Overcurrent protection (1)” screen.

The timed HIGH2 characteristics settings can be found in the console on the “Overcurrent Protection (HIGH 2)” screen. To see families who may have timed HIGH2 characteristics (see section “1.2 Functions”).

The remarks on curves and accuracy in times are the same as those quoted for phases.

Timed neutral inhibition setting (4 tables)

This setting is located in the "TOC Limitations" screen under the "Phase TOC Limitations" heading, or via the keyboard/display (in PROTEC. FUNCTION., in NEUT. TOC. LIMIT.).

Setting	Minimum	Maximum	Step	Remarks
Limit current (A)	0,02 0,005 0,008 0,002 0,1	20,0 5,000 3,000 2,000 100,0	0,01 0,001 0,001 0,001 0,01	IT / IS family(Models C and D) IS family (Models A and B) RC family (Model A) RC family (Model C) Other families

The neutral timing inhibition setting enables the inhibition of this characteristic as of the start-up of the neutral instantaneous characteristic.

The limit current is the current beyond which the curve is no longer followed and the time given by the curve for the value in question increases, that is to say, the curve becomes a horizontal line as of that value. If this value is not to be used, the maximum value is to be programmed.

Instantaneous characteristic settings ranges (low level) (4 tables) (normal and HIGH2)

Setting	Min	Max	Step	Remarks
Instantaneous neutral enabling				YES/NO
Instantaneous neutral trip (A)	0,02 0,005 0,008 0,002 0,1	20,0 5,000 3,000 2,000 100,0	0,01 0,001 0,001 0,001 0,01	IT / IS family(Models C and D) IS family (Models A and B) RC family (Model A) RC family (Model C) Other families
Additional instantaneous time (s)	0,00	60,00	0,01	

The instantaneous normal characteristics settings can be found in the console on the "Overcurrent protection (1)" screen.

The instantaneous HIGH2 characteristics settings can be found in the console on the "Overcurrent Protection (HIGH 2)" screen. To see families who may have timed HIGH2 characteristics (see section "1.2 Functions").

The trip current is set in Amperes in the secondary.

The remarks on activation times are the same as those provided for phases.

Instantaneous characteristic setting ranges (high level) (4 tables)

Setting	Min	Max	Step	Remarks
Instantaneous neutral enabling				YES/NO
Instantaneous neutral trip (A)	0,02 0,1	20,0 100,0	0,01 0,01	IT family (Model D) Other families
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in the Console in the "Instantaneous overcurrent protection (HIGH 1)" screen.

The time characteristics are the same as those provided for phases.

1.26 DIRECTIONALITY OF THE NEUTRAL OVERCURRENT PROTECTIONS

In the ID family, the protection functions described can be directional.

In such a case, each of the functions (timed, low instantaneous, high instantaneous) has an additional setting, "Torque control", which if set YES indicates that the function is to act as directional and if set to NO it must act as NON DIRECTIONAL

Note.- Even when the Torque Control is set at YES, the directionality can be locked (forced to operate as non-directional) by a Procome command or by a digital or logic input (if programmed as "Directional" in the "Locks (I)" screen).

The settings corresponding to the directionality criteria are found in the "Overcurrent protection (2)" screen in the "DIRECTIONAL" section. The options are shown below, followed by descriptions of the functions.

Neutral lead/lag (degrees). Programmable from 0º to 360º. It corresponds to the angle setting between the polarization voltage and the maximum torque line (LMP).

Polarization voltage. This is the minimum polarization voltage value, below which it is considered that the direction is not known with certainty.

Trip permission without V.Polarization. If set to YES, it enables an overcurrent trip if the polarization voltage is lower than the minimum polarization voltage; if set to NO, the overcurrent trip is not allowed under those conditions.

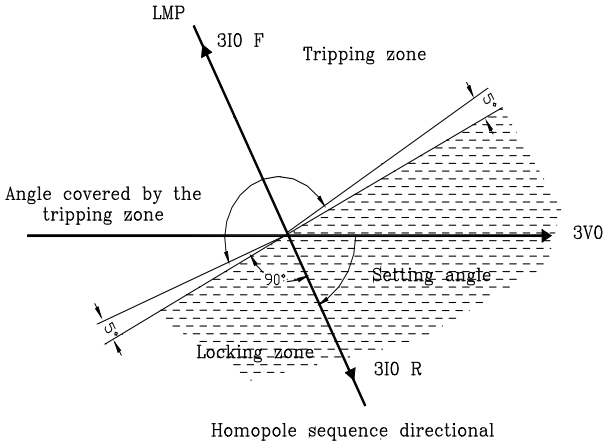
Zone Amplitude (degrees). Programmable between 0º and 170º. It corresponds to the angle covered by the trip zone.

Neutral directional (67N); polarization by SO (VO)

Operation with polarization by VO, zero sequence voltage

The direction is determined using the neutral current (3·IO) with the neutral voltage as polarization, (3·VO). The angle determines the range in which the fault is considered as a forward fault and as a reverse fault. A forward fault is recognised in accordance with the following:

$$90\text{-lead/lag setting} < \arg(IO) - \arg(VO) < 270\text{-lead/lag setting}$$



There is a 5° zone between the non-trip zone and the trip zone in which the current directional status is maintained. We must remember that the trip zone is limited by the zone Amplitude setting by which it is determined. For example: if this setting is set to 170 degrees, the trip zone would be the maximum. However, if it is set to 0 grades, the trip zone would be reduced to the maximum torque line (LMP).

Torque control

The directional lock is used when the polarization voltage (3·V0) falls below the threshold (V polarization setting), which when set to YES indicates forwards and when set to NO indicates reverse.

Signs

Provides forward and reverse signs. (Forward, Reverse).

When the directional lock is set to "NO" and the polarization magnitudes are below the threshold, the direction is not signalled.

When the directional lock is set to "YES" and the polarization magnitudes are below the threshold, it signals forward and reverse.

1.27 SENSITIVE NEUTRAL OVERCURRENT PROTECTION

General description

Sensitive neutral overcurrent protection, with the same characteristics options as those described for phases (except that there is only one instantaneous element), and independent settings (function 50SN/51SN).

Timed characteristic settings ranges (4 tables) (normal and HIGH2)

Setting	Minimum	Maximum	Step	Remarks
Neutral timing enabled				YES/NO
Sensitive neutral timed pickup (A)	0,02 0,005 0,008 0,002 0,1	20,0 5,000 3,000 2,000 100,0	0,01 0,001 0,001 0,001 0,01	IT / IS family(Models C and D) IS family (Models A and B) RC family (Model A) RC family (Model C) Other families
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,0	600,0	0,1	

The timed normal characteristics settings can be found in the console on the “Overcurrent protection (1)” screen.

The timed HIGH2 characteristics settings can be found in the console on the “Overcurrent Protection (HIGH 2)” screen. To see families who may have timed HIGH2 characteristics (see section “1.2 Functions”).

The remarks on curves and accuracy in times are the same as those quoted for phases.

Timed sensitive neutral inhibition setting (4 tables)

This setting is located in the "TOC Limitations" screen under the "Sensitive neutral phase TOC Limitations" heading, or via the keyboard/display (in PROTEC. FUNCTION., in SENN TOC. LIMIT.).

Setting	Minimum	Maximum	Step	Remarks
Limit current (A)	0,02	20,0	0,01	IT / IS family(Models C and D)
	0,005	5,000	0,001	IS family (Models A and B)
	0,008	3,000	0,001	RC family (Model A)
	0,002	2,000	0,001	RC family (Model C)
	0,1	100,0	0,01	Other families

The sensitive neutral timing inhibition setting enables the inhibition of this characteristic as of the start-up of the sensitive neutral instantaneous characteristic.

The limit current is the current beyond which the curve is no longer followed and the time given by the curve for the value in question increases, that is to say, the curve becomes a horizontal line as of that value. If this value is not to be used, the maximum value is to be programmed.

Instantaneous characteristic settings ranges (low level) (4 tables) (normal and HIGH2)

Setting	Minimum	Maximum	Step	Remarks
Instantaneous neutral enabling				YES/NO
Instantaneous sensitive neutral trip (A)	0,02	20,0	0,01	IT / IS family(Models C and D)
	0,005	5,000	0,001	IS family (Models A and B)
	0,008	3,000	0,001	RC family (Model A)
	0,002	2,000	0,001	RC family (Model C)
	0,1	100,0	0,01	Other families
Additional instantaneous time (s)	0,00	600,00	0,01	

The instantaneous normal characteristics settings can be found in the console on the “Overcurrent protection (1)” screen.

The instantaneous HIGH2 characteristics settings can be found in the console on the “Overcurrent Protection (HIGH 2)” screen. To see families who may have timed HIGH2 characteristics (see section “1.2 Functions”).

The trip current is set in Amperes in the secondary.

The remarks on activation times are the same as those provided for phases.

Instantaneous characteristic setting ranges (high level) (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Instantaneous neutral enabling				YES/NO
Instantaneous sensitive neutral trip (A)	0,02	20,0	0,01	IS family (Model D)
	0,005	5,000	0,001	Other families
Additional instantaneous time (s)	0,00	600,00	0,01	

These settings can be found in the Console in the “Instantaneous overcurrent protection (HIGH 1)” screen.

The time characteristics are the same as those provided for phases.

1.28 RESIDUAL CURRENT OVERCURRENT PROTECTION

General description

This overcurrent protection function works with the residual current, which is the sum of the phase currents internally calculated by the unit. It has the characteristics options as those described for phases, and independent settings (function 50R/51R).

This function may be used in those situations in which a ground trafo is not available or it has to protect an earthed or similar line.

Note: Due to the fact that the measurement results from the sum of the phase currents, this function's error is considered to be the sum the errors of the currents circulating through the phases.

Timed characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Timed residual current enabling				YES/NO
Timed pickup (A)	0,1	100,0	0,01	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,0	600,0	0,1	

These settings can be found in "PL70 Protection" screen in the Console.

The remarks on curves and accuracy in times are the same as those quoted for phases.

Instantaneous characteristic settings ranges (single level) (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Instantaneous enabling				YES/NO
Instantaneous trip (A)	0,1	100,0	0,01	
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in "PL70 Protection" screen in the Console.

The trip current is set in Amperes in the secondary.

The remarks on activation times are the same as those provided for phases.

1.29 CURRENT UNBALANCE PROTECTION

General description

This protection contains the instantaneous and timed unbalance protection functions.

The protection works in exactly the same way as the phase overcurrent protection, taking three times the inverse sequence current module as an input measurement.

$$3 \bullet \left| \vec{I}_2 \right| = \left| I\vec{a} + a^2 \bullet I\vec{b} + a \bullet I\vec{c} \right| \qquad \text{In which=1l120°}$$

The fact that the phase succession order A-B-C or C-B-A can be programmable, meaning that I2 depends on this setting, must be taken into account.

Timed characteristic settings ranges (4 tables)

Parameter	Min	Max	Step	Remarks
Timed unbalance enabling.				YES/NO
Unbalance timing pickup (A)	0,1	100,0	0,01	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,1	600,0	0,1	

These settings can be found in the console on the “Overcurrent protection (1)” screen.

The remarks about the curves are the same as those provided for phases.

Instantaneous characteristic settings ranges (4 tables)

Parameter	Minimum	Maximum	Step	Remarks
Instantaneous unbalance enabling.				YES/NO
Instantaneous unbalance trip (A)	0,1	100,0	0,01	
Additional instantaneous time (s)	0,10	60,00	0,01	

These settings can be found in the console on the “Overcurrent protection (1)” screen.

The remarks about additional time are the same as those provided for phases.

1.30 BROKEN CONDUCTOR PROTECTION

General description

This is a definite time protection unit. The pick-up value to be set is, expressed as a decimal, the ratio in modules between the inverse sequence and direct sequence current.

$$\left|\frac{\vec{I}_2}{\vec{I}_1}\right| = \frac{\left|I\vec{a} + a^2 \bullet I\vec{b} + a \bullet I\vec{c}\right|}{\left|I\vec{a} + a \bullet I\vec{b} + a^2 \bullet I\vec{c}\right|}$$

In which=1|120º

The relay trips once the programmed time has elapsed from the moment the pickup setting value is exceeded. In order for this unit to operate, the current of certain of the phases must be at least 0.3 A, and both the direct and indirect sequences must be at least 0.15 A (in the secondary).

This function is different in the MO family:

While the motor is within the pickup period (see section 4.10.1.1), the effective setting is not the programmed setting, but 0.8, dropping out to 0.76. Once the relay has picked up, it will trip when the setting value is exceeded, dropping to 80%. Additionally, this function locks if any of the currents exceeds 5 times the programmed "Rated current". This functionality is conditioned by the “Operation mode” setting (see section 3.6.3), which can be programmed as "MOTOR" or "GENERATOR". The description given for a motor within the pick up period can not be applied if it is programmed as generator. In this case, the function always employs the programmed setting and does not lock, even when the current is 5 times the rated value.

Settings range (4 tables)

Setting	Min	Max	Step	Remarks
Broken conductor unit enabling.				YES/NO

Broken conductor timing pick (A)	0,10	0,50	0,01	Expressed as a decimal. I_2/I_1
Definite time(s)	0,05	300,0	0,01	

These settings can be found in the console on the “Overcurrent protection (2)” screen.

1.31 G1 OVERCURRENT PROTECTION (50/51G1)

General description

Neutral 2 overcurrent protection, with the same characteristics options as those described for phases (except that there is only one instantaneous element), and independent settings (function 50G1/51G1).

This function can be used to protect an earthed line or similar.

Timed characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Timer enabling				YES/NO
Timed pickup (A)	0,02 0,1	20,0 100,0	0,01 0,01	RT family (Model C) Other families
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,0	600,0	0,1	

These settings can be found in “PL70 Protection” screen in the Console.

The remarks on curves and accuracy in times are the same as those quoted for phases.

Instantaneous characteristic settings ranges (single level) (4 tables)

Setting	Min	Max	Step	Remarks
Instantaneous enabling				YES/NO
Instantaneous trip (A)	0,02 0,1	20,0 100,0	0,01 0,01	RT family (Model C) Other families
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in “PL70 Protection” screen in the Console.

The trip current is set in Amperes in the secondary.

The remarks on activation times are the same as those provided for phases.

1.32 G2 OVERCURRENT PROTECTION (50/51G2)

General description

Neutral 3 overcurrent protection, with the same characteristics options as those described for phases (except that there is only one instantaneous element), and independent settings (function 50G2/51G2).

This function can be used to protect an earthed line, tank or similar.

Timed characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Timer enabling				YES/NO
Timed pickup (A)	0,1	100,0	0,01	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,0	600,0	0,1	

These settings can be found in “PL70 Protection” screen in the Console.

The remarks on curves and accuracy in times are the same as those quoted for phases.

Instantaneous characteristic settings ranges (single level) (4 tables)

Setting	Min	Max	Step	Remarks
Instantaneous enabling				YES/NO
Instantaneous trip (A)	0,1	100,0	0,01	
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in “PL70 Protection” screen in the Console.

The trip current is set in Amperes in the secondary.

The remarks on activation times are the same as those provided for phases.

1.33 UNDERCURRENT PROTECTION

As of version “a”, the PL70 IT and IS models include Undercurrent protection.

There are two definite time undercurrent levels, based on the minimum current of the three phases.

The function picks up when one of the three phase currents falls below the setting.

The choice of open- and closed-breaker trips is selectable. (Checking the 52 status input).

When trip is produced by this function, the general trip is activated and the recloser is locked. Drop out is produced at 105% of the pick up setting.

Setting	Minimum	Maximum	Step	Remarks
Timer enabling				YES always / YES with breaker closed / NO
Undercurrent pickup level 1	0,1	10,00	0,01	
Additional timing level 1	0	600,00	0,01	
Undercurrent pickup level 2	0,1	10,00	0,01	
Additional timing level 2	0	600,00	0,01	

These settings can be found in the console on the “Overcurrent protection (4)” screen.

The trip current is set in Amperes in the secondary.

The remarks on performance times are the same as those provided for phase overcurrent.

1.34 MOTOR PROTECTION

The motor protection functions are detailed below.

Note: The settings corresponding to the "In" current employed in the motor protection functions may be adjusted solely via keyboard/display in the "General" section. For further information, see the "General settings" section.

Rotor lock protection

General description

A definite time, overcurrent protection. It compares the average current with the programmed value and, in the event of the programmed value being exceeded, trips the programmed time. It is disabled during the start-up of the motor. Function 51RB.

The motor is considered to be within the pickup period during the time interval in which it passes from 0 to 1.2*In, after having been at 2*In, that is, when the current is already decreasing.

There is a special setting (see section 3.6.3) called "Operation mode" that can be programmed as "MOTOR" or "GENERATOR". The description given for a picked up motor is not applicable if it is programmed as generator, that is, when the function is enabled and provided that "Enabling" setting is set to "YES".

Settings range (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Rotor unit lock enabled				YES/NO
Rotor lock timer pick-up (A)	1	50	0,1	
Definite time(s)	0	30	1	

Undercurrent protection (cut-out)

General description

A definite time protection. It compares the average current with the programmed value and, in the event of a shortcoming, trips the programmed time (if the breaker is closed). Function 37.

There is a special setting (see section 3.6.3) called "Operation mode" that can be programmed as "MOTOR" or "GENERATOR". In the case of generators, this function neither picks up nor trips.

Settings

Setting	Minimum	Maximum	Step	Remarks
Undercurrent unit enabled				YES/NO
Undercurrent timed pick-up (A)	0,2	5,0	0,1	
Definite time(s)	0	30	1	

Long start protection

General description

This protection produces a trip if the pick-up period is superior to the programmed time. Function 48. In order for a drop-out to occur, the fictitious temperature must be less than 40% of the maximum value (in addition to the normal trip sealing conditions).

There is a special setting (see section 3.6.3) called "Operation mode" that can be programmed as "MOTOR" or "GENERATOR". In the case of Generators, this function has no effect.

Settings range (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Long-start function enabled				YES/NO
Pick-up time (sec)	1	99	1	

Protection against successive starts

General description

This protection counts the number of attempted starts that take place within a programmed time span. If the programmed number is exceeded, the trip signal is activated in order to prevent further starts. The signal is maintained during the programmed period. The start counter may be reset by forcing the release with the key ↓.

There is a special setting (see section 3.6.3) called "Operation mode" that can be programmed as "MOTOR" or "GENERATOR". In the case of Generators, this function has no effect.

Settings range (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Successive-start function enabled				YES/NO
Number of starts	1	15	1	
Time span (minutes)	1	120	1	
Output activation time (minutes)	1	100	1	

1.35 PHASE CHARACTERISTIC CONTROL BY VOLTAGE (FUNCTION 51V)

The timed phase protection function can be controlled by voltage in such a way that the pick up current decreases if the control voltage is inferior to the rated current. To activate this function, the “Voltage acceleration” setting in the “Overcurrent protection 1 –Phases” settings screen (or, via keyboard/display, the PROTECTION-PHASE TIME-ENABLE ACCELARATION) must be set to "YES". (If it is set to “NO”, the effective settings are those programmed in phase timing).

The control by voltage function has two operational modes, depending on the programming of the “Voltage control” setting in screen 3of the Overcurrent Protection Settings screen (or by keyboard/display, FUNCTION PROTEC-PA.CRTLV-ENABLE). If this setting is set to “NO”, the unit works according to control mode 1; if it set to “YES”, according to mode 2.

Mode 1 (51V).

The phase pick up current is controlled by the phase to phase voltage V, which acts as a control.

When the control voltage is 10% of the rated value, the controlled pick up current is the 10% of the programmed value.

When the control voltage is 90% of the rated value, the controlled pick up current is the 90% of the programmed value.

Between both values, the variation of the pick up current in relation to the control voltage is lineal.

For control voltage values higher than the 90% of the rated value, the pick up current is the programmed value.

Mode 2 (51V).

When the control voltage is lower than a programmed value, function 51’s effective settings switch from those programmed in "phase timing" to those programmed as “control by voltage”.

This function is subordinated to the phase timing function, in the sense that it makes the phase timing operate with other settings. However, if the phase timing function is disabled, function 51V has no effect.

The settings are as follow:

Enabling of voltage control: YES/NO (as mentioned before, YES to function in mode 1, NO in mode 2, providing that the phase timing “Acceleration” setting is set to “YES”).

Control voltage: 10 a 200 V

Phase timing characteristic settings (pick-up, curve, time, etc.), corresponding to “voltage control”.

1.36 RESTRICTED EARTH PROTECTION (NEUTRAL DIFFERENTIAL 87N)

General description

The function compares the neutral current of one side of the breaker with the neutral current (residual current) of the other side of the breaker. The analysis can be carried out from the two perspectives:

Magnitude: if the difference between the residual current and the neutral current (algebraic sum), following the application of their respective transformation ratios, is to exceed the programmed threshold.

$$\left|\left(\frac{RTI_{T4}}{RTI_{T5}} \bullet I_N - I_{Res}\right)\right| \geq Setting$$

Directional: It must indicate that the fault is internal: the neutral current phase of the both sides of the breaker must be opposite in order to be considered an internal fault. If the residual current is less than 80mA, the directional is not taken into account. If the neutral current is less than 90mA, the trip is not permitted.

The restricted earth trip signals are emitted if the directional indicates an internal fault and the difference between both magnitudes is greater than the threshold.

The trip effected in this unit locks the closure order until it is restored by an input.

Important: in the NT family, the protection function acts with the Neutral current measurements and the G1 current. For the rest of the families that include this function, it acts with the Neutral current and the residual current (internally calculated from the phase currents).

Settings ranges

Setting	Min	Max	Step	Remarks
Instantaneous enabling				YES/NO
Trip (A)	0,2	100,0	0,01	
Additional time (s)	0,00	10,00	0,01	

1.37 COLD LOAD PICKUP

Description

This function is aimed at avoiding untimely trips when the load returning to a line that has been without supply for a certain period exceeds the value set for the protection without a fault having occurred, due to the expiry of the “off “period of all the oven-, heater-, cooler-, etc. type loads and the simultaneous reconnection of all such elements. Such situations produce a heavy inrush current in the line which, nevertheless, can be supported for a certain period.: The effect can be produced not only upon the manual closure of a breaker that has been open for a period, but also with a permanently closed breaker, due to the opening of a breaker up-current.

This function detects such conditions and changes the trip settings during a programmable time.

The function is activated when the current in the 3 phases is below 0.1 A. In such circumstances, it begins to meter the programmed time to determine that the load is “cold” (this period can be 0, meaning that the opening of a circuit breaker would lead to a cold load situation). Once the period has expired and the current has not exceeded 0.2 A once more, the protection’s normal settings values are replaced by the cold load values. When any of the phase currents exceeds 0.2 A, the metering of a programmable begins, during which the cold load settings remain active. Upon the expiry of this period, the normal settings become active once again.

Settings (table 0, single)

They are accessed via the keyboard/display in "Table 0" - "Protections" - "Cold load pick up", or through the Console in the screen “Overcurrent- -Cold load Prot.” and they replace the standard functions when the condition is given:

Phase timing

Neutral timing

Phase instantaneous

Neutral instantaneous

Sensitive neutral timing

Sensitive neutral instantaneous

Under the name "Cold load pickup", they are also the settings that define the function's range of activity:

"Cold load" function enabling: YES/NO

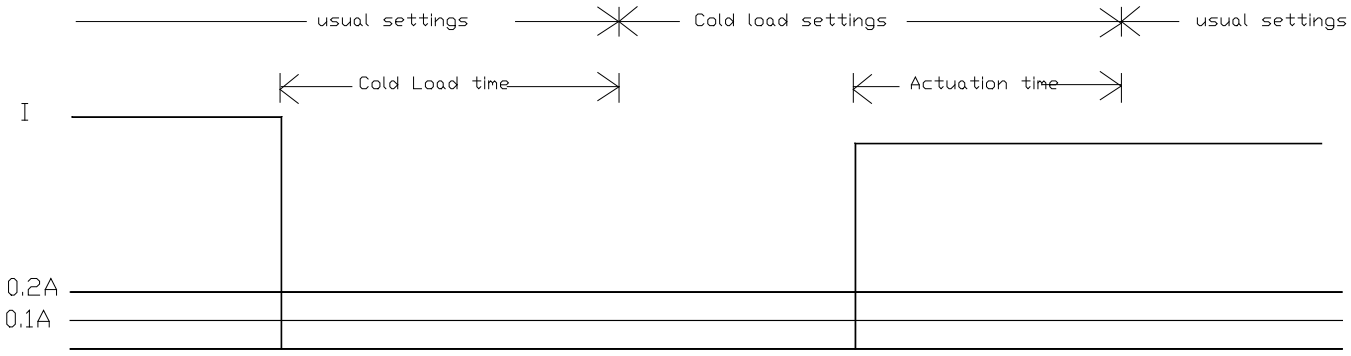
Cold load determination time: 0 to 10000 sec. In Console "Cold load time"

"Cold load" settings operating time: 1 to 3600 sec. (1 hour). In Console "Performance time". During this time, and following the return of the current (>0.2A), all the overcurrent protection settings (phase, neutral and sensitive neutral) cease corresponding to the "active table" and correspond to "cold load": enabling, pickups, curves, times, etc.

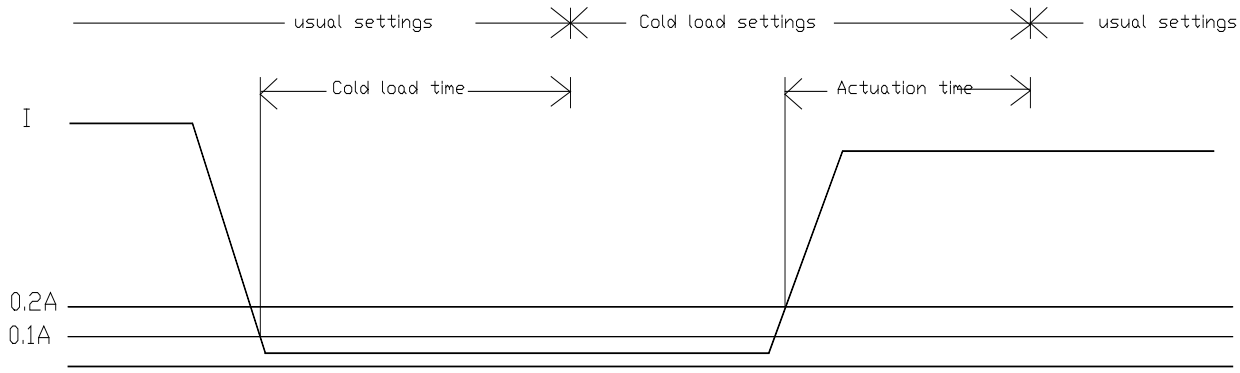
Remarks:

The "cold load" function is deactivated while the unit is on "ongoing cycle", that is to say, while the closure control is assumed by the Reclosure function.

Example with opening and closure of breaker



Example with very low load



1.38 ISOLATED NEUTRAL PROTECTION

General description

The "Directional zero-sequence relay" function incorporated into the protection carries out a directional protection against earth faults in isolated neutral systems (function 67 NA). It can also be used as non-directional.

Input signals

Zero sequence current (IG): It comes from the connection in parallel of the secondaries of 3 phase current transformers or from a toroid transformer handling the 3 phases.

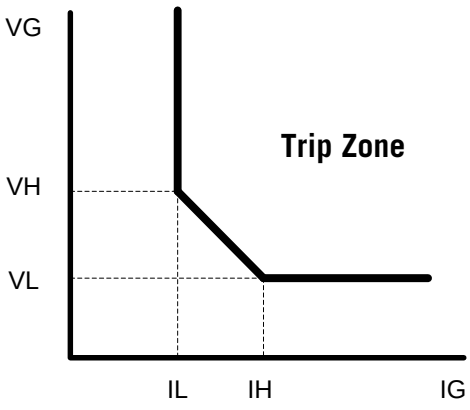
Zero sequence voltage (VG): If there are phase to earth voltage signals for each phase, it can be calculated internally. If not, it is measured from the open delta connection of three voltage transformers, with secondary rated voltage of 110/√3 V. A setting indicates which of the procedures is used.

Measurement ranges

Current: 5mA to 1A

Voltage: 0.5V to 200V (3*110/√3)

The characteristic curve of this protection function is as follows:



The following parameters are adjustable

Isolated neutral unit enabling. When set to "YES", the protection unit is allowed to act. When set to "NO", the protection unit is inhibited.

Torque control ("External lock"). If set to "YES", it operates as directional, checking the angle between VG and IG; if set to "NO", it does not check the angle, i.e., it functions as non-directional.

Low current (IL of the characteristic curve). Range 0.005 to 1 A, with 1 mA resolution.

High current (IH). Range 0.005 to 1 A, with 1 mA resolution.

IH >= IL must be fulfilled.

Low voltage (VL). Range 0.5 V to 60 V. 0.1 V resolution.

High voltage (VH). Range 0.5 V to 60 V. Resolution 0.1 V. VH >= VL must be fulfilled.

First trip timing. Range 0 to 60 sec. Resolution 0.01 sec.

Inst. switching time. Range 0 to 10 sec. Resolution 0.1 sec.

Amplitude angle (degrees). Range 90 to 170. Resolution 1º.

Functioning as directional, the relay trips when the point defined by the VG and IG measured values lies within the characteristic zone's trip region. In relation to VG, the IG HAS A LAG within the interval indicated by the "Amplitude angle parameter / 2" parameter ± 90º. When functioning as "non-directional", the only trip condition is that of falling within the characteristic area, irrespective of the angle.

The first trip is timed according to the corresponding parameter's setting. The successive trips that occur during the time programmed as "switching time" as of the first trip are instantaneous; the first trip as of this that time is timed once again.

Settings ranges

Parameter	Minimum	Maximum	Step	Remarks
Isolated neutral enabling				YES/NO
Torque control ("External lock")				
Low current (A)	0,005	1	0,001	
High current (A)	0,005	1	0,001	
Low voltage (V)	0,5	60,0	0,1	
High voltage (V)	0,5	60,0	1	
First trip timing (s)	0,0	60,0	0,1	
Inst. switching time	0,0	10,0	0,1	
Amplitude angle (degrees).	90	170	1º	

1.39 SURGE PROTECTION

General description

Three-phase surge protection, with the following selectable characteristics (function 59):

Timed characteristic

Normal inverse time. (I BSC or I ANSI)

Short inverse time (IL BSC)

Long inverse time (IL BSC)

Very inverse time. (MI BSC or MI ANSI)

Extremely inverse time. (EI BSC or EI ANSI)

Special very inverse time (MIEs BSC)

Moderately inverse time (ANSI)

User curve (USUAR 1)

Definite time

Instantaneous characteristic:

Instantaneous element.

Additional time.

Timed characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Phase time enabling				YES/NO
Timed phase pick up (V)	5	200	0,1	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,00	600,00	0,01	

These settings can be found in the "Voltage Protection" screen in the Console.

The timed response curves are the same as those used by the overcurrent protections.

The pickup voltage is set in Volts in the secondary.

In definite time, the relay trips upon the expiry of the programmed time as of the moment in which the start-up voltage is exceeded, independently of the current value.

When working with curves, the time that passes prior to the trip depends on the selected curve (family and index) and the voltage value. Appendix II contains graphs and formula for calculating the time in accordance with the quotient between the voltage and the pickup voltage.

The remarks on the accuracy of the timings are the same as those provided for the overcurrent function.

Instantaneous characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Instantaneous phase enabling				YES/NO
Instantaneous phase trip (V)	5	200	0,1	
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in the "Voltage Protection" screen in the Console.

The trip voltage is set in Volts in the secondary.

The remarks about times are the same as those for the overcurrent function.

1.40 UNDERVOLTAGE PROTECTION

General description

Three-phase undervoltage protection with the following selectable characteristics (function 27):

Timed characteristic

Normal inverse time. (I BSC or I ANSI)

Short inverse time (IL BSC)

Long inverse time (IL BSC)

Very inverse time. (MI BSC or MI ANSI)

Extremely inverse time. (EI BSC or EI ANSI)

Special very inverse time (MIEs BSC)

Moderately inverse time (ANSI)

User curve (USUAR 1)

Definite time

Instantaneous characteristic:

Instantaneous element.

Additional time.

The functioning of this protection does not cause automatic reclosure.

Timed characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Phase timing enabling				YES/NO
Timed phase pick up (V)	5	200	0,1	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,00	600,00	0,01	

These settings can be found in the “Voltage Protection” screen in the Console.

The timed response curves are the same as those used by the overcurrent protections.

The pickup voltage is set in Volts in the secondary.

In definite time, the relay trips upon the expiry of the programmed time as of the moment in which the value falls below the start-up voltage, independently of the voltage value.

When working with curves, the time that passes prior to the trip depends on the selected curve (family and index) and the voltage value. Appendix II contains graphs and formula for calculating the time in accordance with the quotient between the voltage and the pickup voltage.

The remarks about times are the same as those for the overcurrent function.

Instantaneous characteristic settings ranges (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Instantaneous phase enabling				YES/NO
Instantaneous phase trip (V)	5	200	0,1	
Additional instantaneous time (s)	0,00	60,00	0,01	

These settings can be found in the “Voltage Protection” screen in the Console.

The trip voltage is set in Volts in the secondary.

The remarks about times are the same as those for the overcurrent function.

1.41 VOLTAGE UNBALANCE PROTECTION

Timed characteristic

This is a definite time protection unit. The pick-up value to be set is, expressed as a decimal, the ratio in modules between the inverse sequence voltage and direct sequence voltage.

The relay trips once the programmed time has elapsed from the moment the pickup setting value is exceeded.

Settings range (4 tables)

Setting	Min	Max	Step	Remarks
Enabling				YES/NO
Broken conductor timing pick (A)	0,10	0,50	0,01	Expressed as a decimal. V2/V1

Definite time(s)	0,0	600,0	0,1	

These settings can be found in the “Voltage Protection” screen in the Console.

Instantaneous characteristic

This is a definite time protection unit. It only checks if the voltage phase succession order is the programmed order or the opposite order. In the event of the latter, it trips following the programmed time.

Settings range (4 tables)

Setting	Min	Max	Step	Remarks
Enabling				YES/NO
Definite time(s)	0,00	60,00	0,01	

The settings of both characteristics can be found in the “Voltage Protection” screen in the Console.

1.42 MAXIMUM ZERO SEQUENCE VOLTAGE PROTECTION

Zero sequence voltage surge protection (function 64 or 59N). The pick-up value to be adjusted is the zero sequence voltage received from the secondary open delta connection of the three voltage transformers.

The function has the following selectable characteristics:

Timed characteristic

Normal inverse time. (I BSC or I ANSI)

Short inverse time (IL BSC)

Long inverse time (IL BSC)

Very inverse time. (MI BSC or MI ANSI)

Extremely inverse time. (EI BSC or EI ANSI)

Special very inverse time (MIEs BSC)

Moderately inverse time (ANSI)

User curve (USUAR 1)

Definite time

Instantaneous characteristic:

Instantaneous element.

Additional time.

The functioning of this protection does not cause automatic reclosure.

The function can be disabled by means of a setting (simultaneously timed and instantaneous).

Settings range (4 tables)

Setting	Min	Max	Step	Remarks
Unit enabling				YES/NO (see Note)
Maximum zero sequence voltage timing pick up (V)	2	200	0,1	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite timed unit time (s)	0	600,0	0,1	
Instantaneous maximum zero sequence voltage pick up (V)	2	200	0,1	
Additional instantaneous unit time (s)	0	60,00	0,01	

Note. These settings can be found in the "Generic Unit" column of the "Voltage Protection" screen in the Console. To be enabled, "Unit type" must be programmed as "SobT" (equivalent to "YES" via keyboard/display), whereas if it is programmed as "SubT" the function is disabled (equivalent to "NO" via keyboard/display).

The timed response curves are the same as those used by the overcurrent protections.

The pickup voltage is set in Volts in the secondary.

In definite time, the relay trips upon the expiry of the programmed time as of the moment in which the start-up voltage is exceeded, independently of the current value.

1.43 FREQUENCY PROTECTION

This function is composed of 5 steps, which are programmable as maximum or minimum frequencies.

Minimum frequency

General description

Each step picks up when the frequency falls below the set value during a number of cycles equal or higher than the "No. of pickup cycles" setting. Once it picks up, the programmed time must elapse in order for a trip to be produced. The unit drops out if the frequency is correct during 2 cycles.

Locks

If the phase B voltage (in the case of three-phase voltage units, TT and SV) is lower than the "Minimum monitoring voltage" setting, the frequency unit is not allowed to pick up. In the case of single-phase units (TF), the single voltage measurement must also be higher than the above-mentioned setting in order to allow the pickup.

Settings (4 tables)

Parameter	Min	Max	Step	Remarks
Minimum frequency enabling.				YES/NO (for each step)
Minimum frequency pick-up (Hz)	40	70	0,01	(for each step)
Definite time(s)	0	600,00	0,01	(for each step)
Minimum monitoring voltage (V)	12	200	1	(for all steps)
Nº of pick-up cycles	3	15	1	(for all steps)

The minimum voltage setting is common for maximum and minimum frequency.

In the Console, the settings corresponding to each step are to be found in the "FREQUENCY PROTECTION" box in the "Frequency protection" screen. The common settings, minimum voltage and number of pickup cycles are found in the "FREQUENCY MONITORING" box.

Frequency rate of change

General description

This function has 4 steps. In each step, a relay is activated if the frequency variation per time unit (frequency decrease) is higher than the set value.

The function is only effective for frequencies inferior to a threshold called "maximum monitoring frequency".

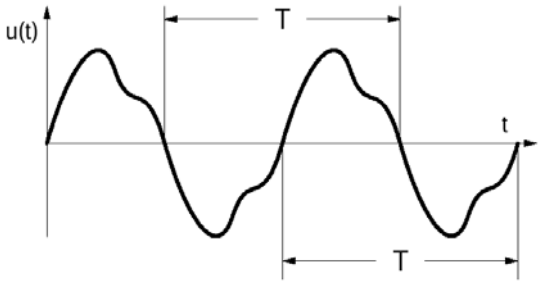
Settings (4 tables)

Parameter	Minimum	Maximum	Step	Remarks

Frequency rate of change / voltage rate of change enabling				YES/NO (for all steps)
Maximum monitoring frequency (Hz)	40	70	0,01	(per step)
Pick-up value (frequency rate of change/voltage rate of change) (Hz/s)	0,2	10	0,05	(per step)
Additional time (s)	0	2	0,01	(per step)
Nº of pick-up cycles D81	3	15	1	(for all steps)

In the Console, the settings corresponding to each step are to be found in the "FREQUENCY RATE OF CHANGE" box in the "Frequency protection" screen. The common settings, minimum voltage and number of pickup cycles D81 (for the rate of change) are found in the "FREQUENCY MONITORING" box.

Each cycle's frequency is measured by refreshing the frequency each half cycle, as shown in the figure:



The algorithm is executed each 5ms in the event of the phase B voltage registering zero.

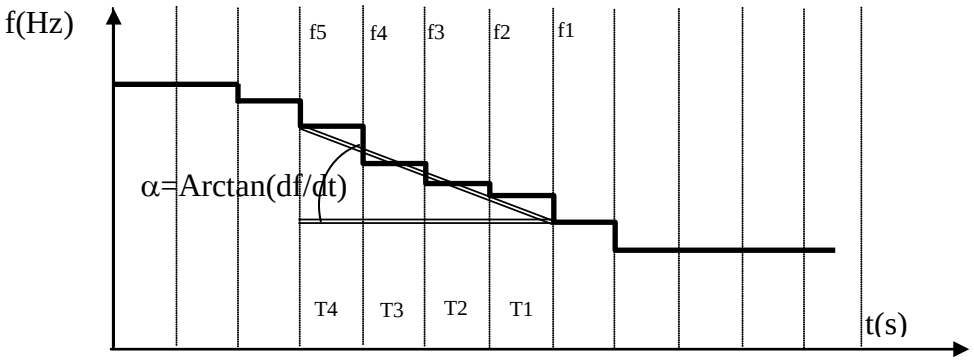
Both the positive and negative registers are measured, although the frequency measurement is carried out for complete cycles. The frequency is measured up to 25Hz. Below this value, the frequency units are not activated.

The algorithm stores the periods of the signal's last 5 cycles and calculates the frequency rate of change by comparing the current cycle's frequency measurement with the measurement taken from 5 cycles previously, taking into account the time lapse between both.

frequency rate of change/voltage rate of change = (f1-f5)/(T1+T2+T3+T4)

In which:

f5 =frequency measurement taken 4 cycles previously	
f4 =frequency measurement taken 3 cycles previously	T4 period of the 4th cycle starting from the end
f3 =frequency measurement taken 2 cycles previously	T3 period of the 3rd cycle starting from the end
f2 =frequency measurement taken 1 cycle previously	T2 period of the 2nd cycle starting from the end
f1 =Last frequency measurement	T1 period of the last cycle



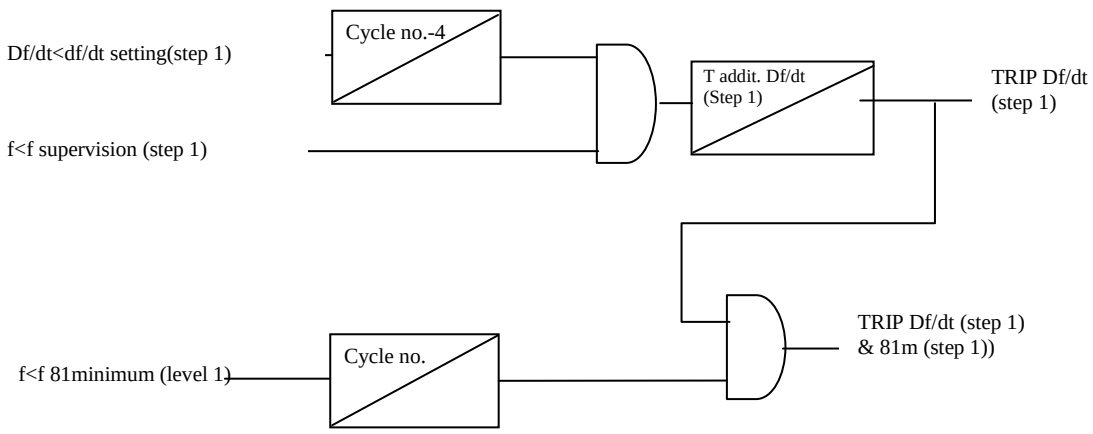
This calculation is repeated, taking into account the measurements separated by two cycles in order to ensure that the frequency has fallen during the entire period, i.e., to ensure that an incorrect measurement does not lead to a trip.

For the unit to pick up, the frequency rate of change must exceed by an absolute value during the set number of cycles.

The pickup only occurs when a negative frequency rate of change/voltage rate of change value is obtained, i.e., when the current frequency is inferior to that measured 5 cycles previously.

During the pickup process, one measurement is allowed to be out of the pickup range without restarting the process. For example, if 3 cycles (set to 7 cycles) are required to cause a pickup, the threshold need only be exceeded 3 times from a total of 4 consecutive measurements.

In order for a trip to occur once the unit has picked up, the frequency rate of change measurement must remain between the set frequency rate of change/voltage rate of change value and a drop out value to the frequency rate of change/voltage rate of change minus 0.05Hz/s during the set time.



If an input is programmed as a breaker associated to the frequency rate of change, the trip is sealed until that input is detected as open.

In order for the unit to drop out once it has picked up, the frequency rate of change/voltage rate of change measurement must be detected as being 0.05Hz/s below the set value.

Locks

The frequency rate of change units lock as a result of:

Minimum monitoring voltage. Similarly, if the phase B voltage is inferior to the setting, the frequency rate of change unit is not allowed to pick up. When the voltage exceeds the set threshold, the relay waits for 10 cycles before running the frequency rate of change function.

Maximum frequency

General description

This function produces a pick up when the frequency exceeds the set value during a number of cycles equal to or greater than the "No. of pickup cycles" setting. Once it picks up, the programmed time must elapse in order for a trip to be produced. The unit drops out if the frequency is correct during 2 cycles.

Locks

If the phase B voltage is inferior to "Minimum monitoring voltage" setting, the frequency unit is not allowed to pick up.

Settings (4 tables)

Parameter	Minimum	Maximum	Step	Remarks
Maximum frequency enabling.				YES/NO
Maximum frequency pick-up (Hz)	40	70	0,01	
Definite time(s)	0	600,00	0,01	
Nº of pick-up cycles	3	15	1	(for all steps)

1.44 THERMAL IMAGE

General description

This function calculates a temperature in accordance with the protected unit's recent and current load conditions. This temperature is displayed as a % in relation to the trip value. When the programmed value is reached, an alarm relay is activated (when programmed), and when it reaches 100%, the thermal image trip relay (if the unit is enabled) and the corresponding signalling are activated. Once the unit has been tripped as a result, the relay does not drop-out while the calculated temperature remains above the drop out threshold setting and the rest of the locking conditions are fulfilled. The calculated temperature can be reset through the keyboard/display (accessing through "↓" to TEMP=0? and pressing ↓ for 2 seconds) or through by means of a console command.

The time which elapses before the trip is determined by the following curves, which establish the time in accordance with the ratio between the current and the programmed rated current, and the programmed heating constant. According to the following formula (starting from temperature 0):

$$t = \tau 1 \cdot \ln \frac{\left(\frac{I}{I_0}\right)^2}{\left(\frac{I}{I_0}\right)^2 - 1}$$

In which t: trip time

τ1 heating constant

I: measured current

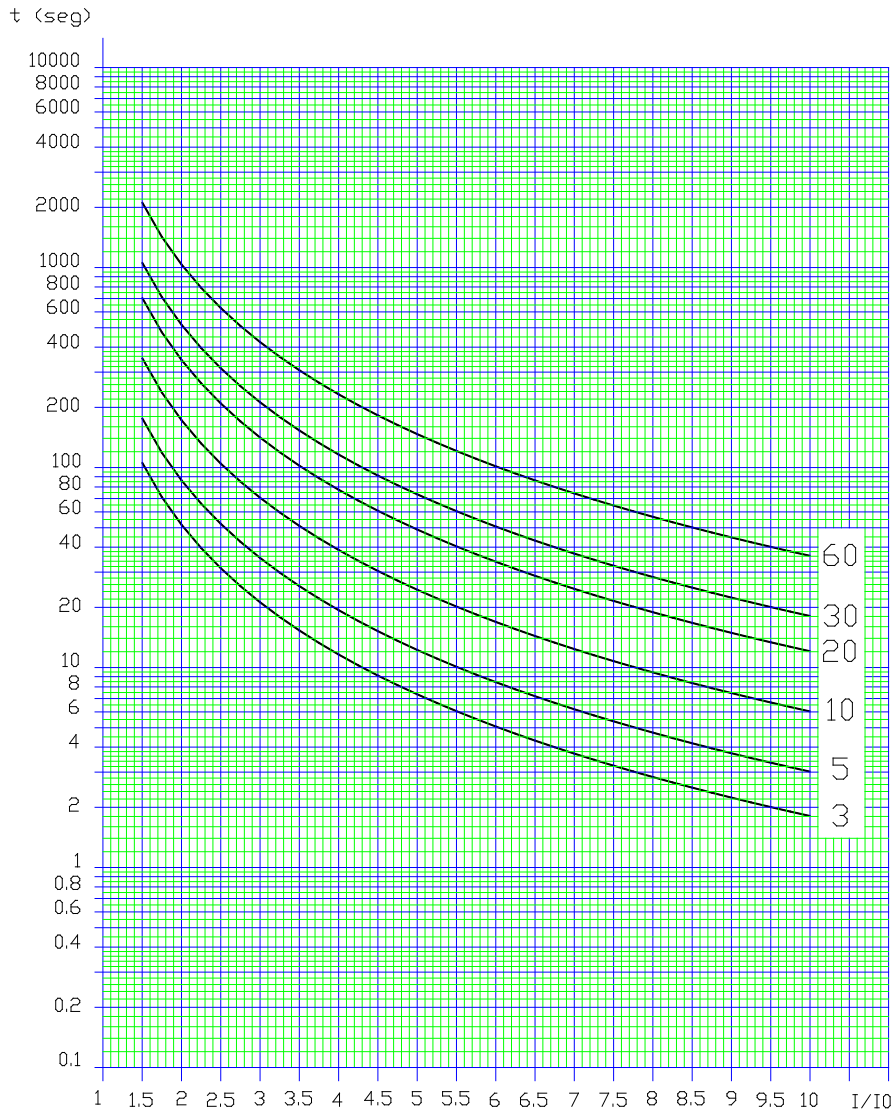
..I0: programmed rated current

Once it has tripped, there is another programmable time constant for the cooling.

Settings

Setting	Min	Max	Step	Remarks
Enabling				YES/NO
Heating time constant (min)	3	60	1	
Cooling time constant (min)	3	180	1	
Alarm threshold (%)	80	100	1	
Drop out threshold (%)	50	99	1	
Rated current (A)	0,02 0,1	20,0 100,0	0,01 0,01	RT family (Model C) Other families

Trip times



Heating curves

The heating curve is calculated using the following formula:

$$T = (T_f - T_i) \cdot \left(1 - e^{\frac{-t}{\tau 1}}\right) + T_i$$

In which: Tf = final temperature

Ti = initial temperature

t = time

$\tau 1$ = heating time constant

For Ti = 0 the formula is reduced to

$$T = T_f \cdot \left(1 - e^{\frac{-t}{\tau 1}}\right)$$

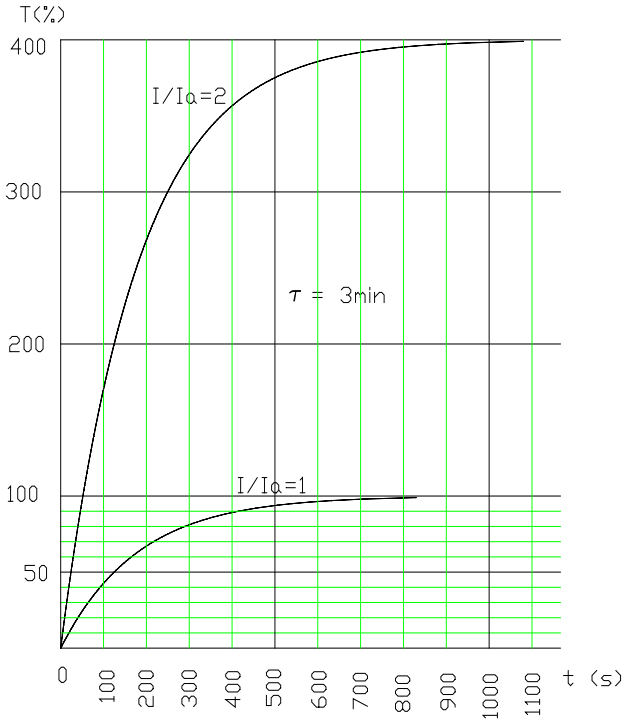
As

$$T_f = \left(\frac{I}{I_0}\right)^2$$

The heating curve is

$$T = \left(\frac{I}{I_0}\right)^2 \cdot \left(1 - e^{\frac{-t}{\tau 1}}\right)$$

The next figure shows examples of heating curves with a 3 minute time constant for I/I0 = 1 and for I/I0 = 2



Cooling curves

The cooling curve is calculated using the following formula:

$$T = (T_f - T_i) \cdot \left(1 - e^{\frac{-t}{\tau 2}}\right) + T_i$$

In which: Tf = final temperature

Ti = initial temperature

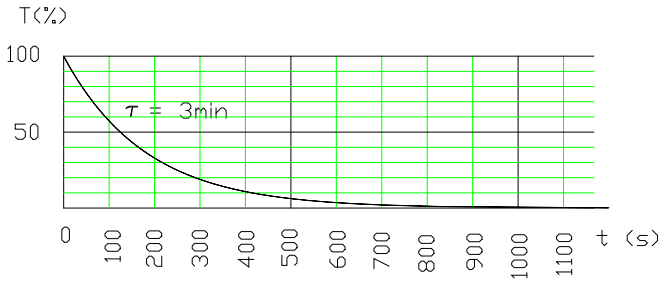
t = time

$\tau 2$ = cooling time constant

Starting from Ti = 1 (100 in %), which is the tripping temperature, the formula employed to obtain a final temperature of Tf = 0 (i.e., current I = 0) is as follows:

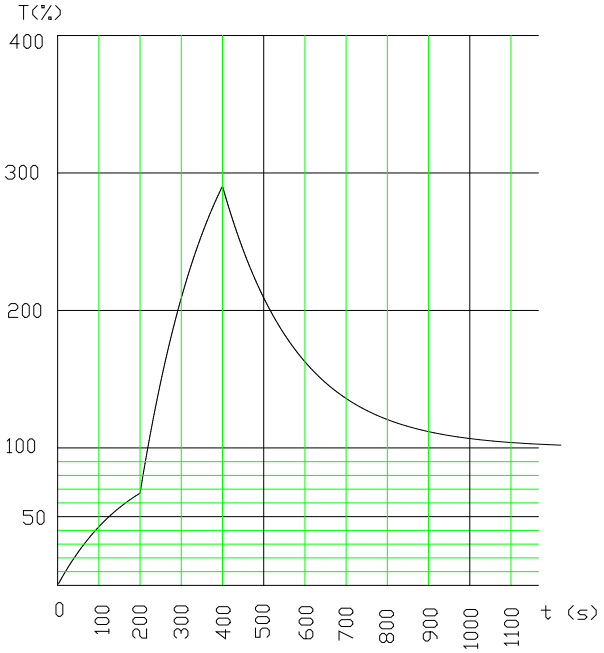
$$T = e^{\frac{-t}{\tau 2}}$$

Example: cooling curve with 3 minute constant

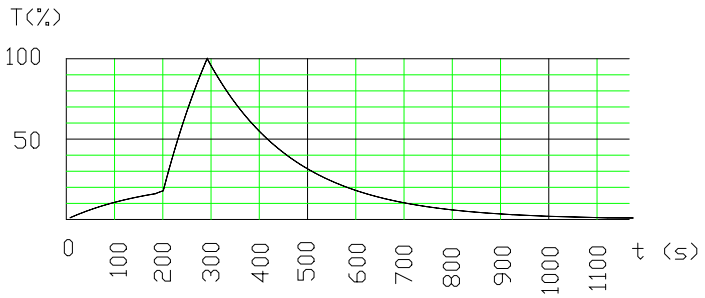


Combined examples of cooling and heating:

1. Supposing that it is heated with I/I0 =1 for 200sec, I/I0 =2 for the next 200 sec (without tripping) and, as of that point, it returns indefinitely to I/I0 = 1 (both with 3 minute time constants):



2. Supposing that it is heated with I/I0 =0.5 for 200sec, I/I0 =1.5 until reaching 100%, at which point the trip is produced, as of that point, it cools with I/I0 = 0 (both with 3 minute time constants):



1.45 PHASE SHIFT

General description

This function produces a trip when a lead/lag variation superior to the set value is detected within a period inferior to 2 cycles.

Settings

Parameter	Minimum	Maximum	Step	Remarks
Enabling of phase shift				YES/NO
Protection lead/lag (degrees)	2	22	1	
Voltage threshold (V)	40	200	1	
Trip type				SINGLE/THREE-PHASE

This function compares the angle of each phase with the angle present during the previous cycle. If it detects that the variation of the angle is greater than the setting value, and provided that the voltage has not dropped between both the measurements by more than 25%; the locking input is deactivated, and the current measured is higher than the setting value, the function will trip.

If the "Trip Type" setting is set as three-phase, the three measurement phases detect the angle lag difference simultaneously; to the contrary, the trip does not occur. However, if it is set as single phase, the trip occurs even when only one of the phases detects the angle variation.

Function limitations with the frequency

When the injected voltage frequency differs from the set rated frequency value (50/60 Hz), the phase shift protection function may trip, in accordance with the setting. The table below details the ratio between the frequency and the phase shift angle setting value.

Fn = 50Hz **Fn = 60Hz**

Frequency	. Phase shift trip		Frequency	. Phase shift trip
49	11		59	11
49.1	10		59.1	10
49.2	9		59.2	9
49.3	8		59.3	8
49.4	7		59.4	7
49.5	6		59.5	6
49.6	5		59.6	5
49.7	4		59.7	4
49.8	3		59.8	3
49.9	2		59.9	2
50.1	2		60.1	2
50.2	3		60.2	3
50.3	4		60.3	4
50.4	5		60.4	5
50.5	6		60.5	6
50.6	7		60.6	7
50.7	8		60.7	8
50.8	9		60.8	9
50.9	10		60.9	10
51	11		61	11

This table indicates that, with an injected current frequency of 49.8 Hz and a rated frequency, the unit will trip directly due to the phase shift if the angle is set to a value equal to or lower than 3º. Above this setting value and at that frequency, the phase shift protection functions correctly.

A limitation for the protection function, dependent on the rated frequency, has also been included. If the rated frequency is 50 Hz, the protection will remain locked for frequency values equal to or lower than 49 Hz, or equal to or

higher than 51 Hz. If the rated frequency is 60Hz, the protection will remain locked for frequency values equal to or lower than 59Hz, or equal to or higher than 61Hz.

1.46 POWER PROTECTIONS

General

Using the current and voltage measurements, the protection calculates the real and reactive power and the power factor and, in accordance with these values, carries out the different protection functions indicated below. The trip thresholds are programmed as a percentage of the rated apparent power, $S = \sqrt{3} \times V \times I$, in which:

V: programmed phase to phase rated voltage

I: 5 A (unit's rated current)

Note: The measurement range is 0.02 to 6 A and the protection range is 0.1 to 10 A
Note: The outgoing real power is considered positive, whilst the incoming real power is considered negative.

Minimum power protection

General description

This function provides protection against excessive decreases in the generated power and compares the real power with the minimum power given by the setting. In the event of the generated power being inferior to the power established in the setting, the protection trips the corresponding relay. Any reverse power will be considered as below the minimum power threshold and will thus activate the function.

Settings ranges

Setting	Min	Max	Step	Remarks
Enabling				YES/NO
Minimum power trip (%)	1,0	200,0	0,1	
Additional time (s)	0,00	60,00	0,01	

The trip power is set as a % of the rated power, which is defined by the rated voltage value and by the protection's rated current.

If an additional time is programmed as 0, the trip will occur in 40 ms. Any additional time programmed is added to the aforementioned time.

Maximum power protection

General description

Provides protection against excessive increases in the power generated.

It functions in a similar manner to that described above. The protection will trip the corresponding relay when the generated real power is greater than the set value. There are two units with different ranges for the additional time, HI-Set and LO-Set.

Settings ranges

Setting	Min.	Max	Step	Remarks
HI-Set enabled				YES/NO
Maximum HI-Set power trip (%)	1,0	200,0	0,1	
Additional HI-Set time (s)	0,00	60,00	0,01	
LO-Set enabling				YES/NO
Maximum LO-Set power trip (%)	1,0	200,0	0,1	
Additional LO-Set time (s)	0,0	600,0	0,1	

Power inversion protection

General description

The protection is activated when the power flow is inverted and exceeds the set value. In such a situation, the protection trips the programmed relay or relays.

This function also provides the option of programming two settings with different timing ranges.

Settings ranges

Setting	Minimum	Maximum	Step	Remarks
HI-Set enabled				YES/NO
HI-Set power inversion trip (%)	1,0	200,0	0,1	
Additional HI-Set time (s)	0,00	60,00	0,01	
LO-Set enabling				YES/NO
LO-Set power inversion trip (%)	1,0	200,0	0,1	
Additional LO-Set time (s)	0,0	600,0	0,1	

Minimum apparent power protection

General description

Provides protection against excessive decreases in the power generated. Employing the voltage and current measurements, the protection calculates the real and reactive power, as well as the power factor, and compares the apparent power with the minimum power according to the setting. In the event of the generated power being inferior to the power established in the setting, the protection trips the corresponding relay.

Settings ranges

Setting	Min.	Max	Step	Remarks
Enabling				YES/NO
Minimum power trip (%)	1,0	200,0	0,1	
Additional time (s)	0,00	60,00	0,01	

The trip power is set as a % of the rated power, which is defined by the rated voltage value and by the protection's rated current (unit's rated current).

Maximum apparent power protection

General description

Provides protection against excessive increases in the power generated.

It functions in a similar manner to that described above. The protection trips the corresponding relay when the generated apparent power is greater than the set value. There are two units with different ranges for the additional time, HI-Set and LO-Set.

Settings ranges

Setting	Min.	Max	Step	Remarks
HI-Set enabling				YES/NO
Maximum HI-Set power trip (%)	1,0	200,0	0,1	
Additional HI-Set time (s)	0,00	60,00	0,01	
LO-Set enabling				YES/NO
Maximum LO-Set power trip (%)	1,0	200,0	0,1	
Additional LO-Set time (s)	0,0	600,0	0,1	

1.47 OVEREXCITATION PROTECTION

General description

Overexcitation protection with the following selectable characteristics (function 24):

Timed characteristic:

Inverse time

Definite time

Instantaneous characteristic:

Instantaneous element

Additional time

This protection has an operating range of 40 to 70 Hz.

Timed characteristic setting range

Setting	Minimum	Maximum	Step	Remarks
Phase timing enabling				YES/NO
Minimum voltage (V)	40	120	1	
Timed phase pick up (%Vn/Fn)	100	400	1	
Timed response type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0	100	0,1	
Drop off time (s)	0	100	0,1	

Since the overexcitation of the protected unit can be assimilated to the voltage quotient (V) between the frequency (Hz), the pick up is set as a decimal of the value of the quotient between the rated voltage and rated frequency.

In definite time, the relay trips upon the expiry of the programmed time as of the moment in which the start-up percentage is exceeded, independently of the overexcitation value.

When working with curves, the time that passes prior to the trip depends on the selected curve (family and index) and the voltage/frequency quotient value. Appendix II contains graphs and formula for calculating the time in accordance with the relation between the voltage/frequency and the pickup voltage/frequency. For quotients higher than 4.0, 4.0 is taken as a value.

The drop off time can be adapted to the protected unit's cooling characteristic, when known. If it is not, a setting from within the prescribed range is used. A lineal drop off model is used, i.e., if the function picks up and the measurement decreases without a trip, the drop off takes into account the time during which the protection has been picked up. If a further pick up occurs before the total drop off is completed, the time prior to a trip is reduced.

An example in the case of Definite time:

Definite time: 10 sec.

Drop off time: 100 sec.

If, following the pick up, the function remains in this status for 4 sec. and the measurement decreases. The total drop off time will be 40 sec. i.e.:

$$Dropofftime(\text{sec.}) = \frac{Setting(Dropofftime)}{Setting(Definitetime)} * Pickuptime$$

If the time during which the measurement decreases is 10sec., the trip time once the function has picked up once more will be 7 sec.

i.e.:

If the function has dropped off for 10sec, it is as if the function had been picked up for 1 sec. less.

$$Pickuptime(\text{sec.}) = \frac{Setting(Definitetime)}{Setting(Dropofftime)} * Dropofftime(\text{sec})$$

Therefore, the trip time is 10-(4-1)=7 sec.

Instantaneous characteristic settings range

Setting	Minimum	Maximum	Step	Remarks
Instantaneous phase enabling				YES/NO
Minimum voltage (V)	40	120	1	
Instantaneous phase trip (% Vn/Fn)	100	400	1	
Additional instantaneous time (s)	0	10	0,01	
Drop off time (s)	0	100	0,1	

The trip is set as a decimal of the value of the quotient between the rated voltage and rated frequency.

If an additional time is programmed as 0, the trip will occur in 60 ms. Any additional programmed time includes the indicated time, i.e., it is time limit for the trip.

Similarly, when a pick up is followed by a drop off without the occurrence of a trip and the trip conditions are repeated without a total drop off occurring, the lineal drop off will provoke the protection into waiting a shorter time before tripping.

1.48 FIELD LOSS PROTECTION

General description

Field loss protection (generator excitation) with the following selectable characteristics (function 40):

2 MHO trip zones with independent settings

1 directional unit common to both zones

1 undervoltage unit common to both zones. The enabling can be carried out independently for each zone.

General field loss settings range

Setting	Minimum	Maximum	Step	Remarks
Function enabling				YES/NO
Minimum voltage pick-up	10,0	65,0	0,1	
Directional unit lead/lag	0	180	1	Clockwise
Phase to which the current trafo is connected .				Phase A / phase B / phase C
Rated voltage	50,0	165,0	0,1	

The setting for the phase to which the current transformer is connected is essential for the correct calculation of the impedance detected by the protection, as this value is calculated using the current and the phase to phase voltage of the other two phases.

The directional unit angle allows the protection to be locked in a specific direction.

Rated voltage: used to provide measurements in Procome format (the scale range of the voltage measurements is 1.2 times the rated voltage).

MHO zone settings range

Setting	Minimum	Maximum	Step	Remarks
Z1A impedance setting (offset) (Ohm)	-20,0	20,0	0,1	
Z1B impedance setting (diameter) (Ohm)	0,0	120,0	0,1	
Zone 1 undervoltage supervision				YES/NO
Zone 1 alarm timing (s)	0,0	9,9	0,1	
Zone 1 trip timing (s)	0,00	9,99	0,01	

Zone MHO 2 has the same settings range as MHO 1.

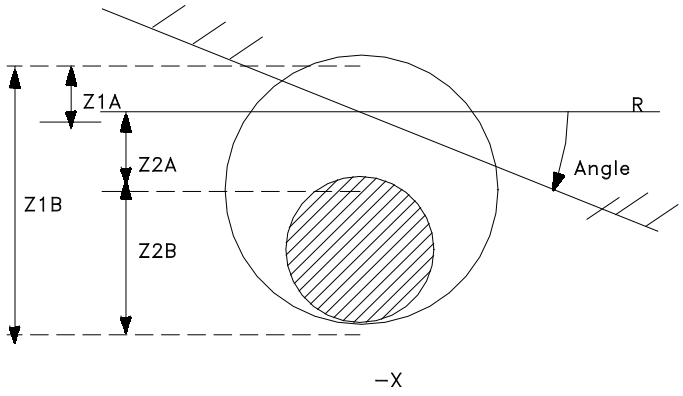
The Z1A and Z1B settings limit the MHO 1 trip zone (in the same way that Z2A and Z2B limit zone MHO 2). The Z1A setting represents the offset (in ohms) of the upper section of the zone. This value can be positive (see Z1A in figure 1) or negative (see Z2A for zone MHO 2). The Z1B setting represents the diameter of the MHO 1 zone.

The protection acts differently depending on whether the zone is in undervoltage conditions or not. A zone is under undervoltage conditions when the following conditions are fulfilled:

The measurement in any of the voltage phases is below the undervoltage pickup value, or

The undervoltage monitoring setting of the zone in question is disabled.

When a generator enters one of these MHO zones, a timer is activated. The alarm signal is produced instantaneously and the trip depends on the timer in use. If the zone is not under these undervoltage conditions, the zone alarm timer is activated. Nevertheless, if the zone is under these undervoltage conditions, the zone's trip will be activated as a timer. This last timer must be set to a value lower than the other timer, as faults must be cleared quickly when the undervoltage conditions occur, given the limited possibilities of the generator recovering and the consequent risk of instability in the electrical system. Once the timer time has elapsed, the corresponding outputs are activated.



1.49 FAULT PASSOVER DETECTION

Isolation of the fault

If the fault passover detection automatism is detected as enabled when the unit is started, or if the automatism is enabled during the unit's normal operation, an internal check is performed to determine whether the unit is ready to function correctly.

The internal checks to be performed are indicated below:

Voltage presence.

V absence with I presence anomaly.

If an input is configured as a breaker status, the breaker is checked as being closed.

PL70 RC the unit cannot be in service.

If the checks are successful, the automatism begins the periodic monitoring of the phase and neutral currents, as well as the presence of voltage. To the contrary, the automatism is disabled and an entry is registered in the event log.

2nd harmonic restraint

This function locks the phase, neutral and neutral sensible fault passover detection (timed and instantaneous) and is equipped with restraint per phase or phases.

If programmed as a phase restraint:

To activate the lock, the following must occur simultaneously at least in the phase in question:

The fundamental current must exceed the minimum restraint value.

The relationship between the 2nd harmonic value and the fundamental must exceed a set threshold.

The 2nd harmonic current must exceed 0.75mA for 3A trafos and 0.50mA for 2A trafos.

The following must be met for the lock to be disabled:

The phase in question is inferior to 95% of the minimum current threshold, or

The phase in question is inferior to 95% of the restraint percentage threshold

This case is the same for the neutral and neutral sensitive. The sensitive neutral settings are the same as the neutral settings.

When programmed as "restraint for all phases", the presence of the conditions in one phase is sufficient to lock the other phases.

The settings (4 tables) are:

Setting	Min	Max	Step	Remarks
Phase enabling				NO Phase restraint Restraint for all phases
Neutral enabling				NO YES
Threshold %I2f/If	5	100	1	
Minimum phase current (A)	0,015 0,003	3,000 3,000	0,001 0,001	Models A and B Models C and D
Minimum neutral current (A)	0,008 0,002	3,000 2,000	0,001 0,001	Models A and B Models C and D

The settings can be found in the “2nd harmonic restraint and manual closure prot. lock” screen in the Console.

Discrimination between inrush faults for instantaneous units

In order to distinguish inrush from instantaneous fault passover detection faults, a wave-form based algorithm has been added. In order to consider a signal as a fault, the wave must exceed 100% of setting in the fundamental component and 80% of the set threshold in instantaneous positive and negative values.

Extinguished current

The extinguished current settings (phase, neutral and neutral sensible) are adjusted in secondary values. This is the maximum current value below which the unit considers that the current is extinguished in the system.

These settings can be found in the "DPF cut organ protection" screen in the Console, or via keyboard/display (within OCR, in EXTING. CURRENT).

Setting	Minimum	Maximum	Step	Remarks
Phase current (A)	0,006	3,000	0.001	
Neutral current (A)	0,002	2,000	0,001	
Sensitive neutral current (A)	0.002	2,000	0,001	

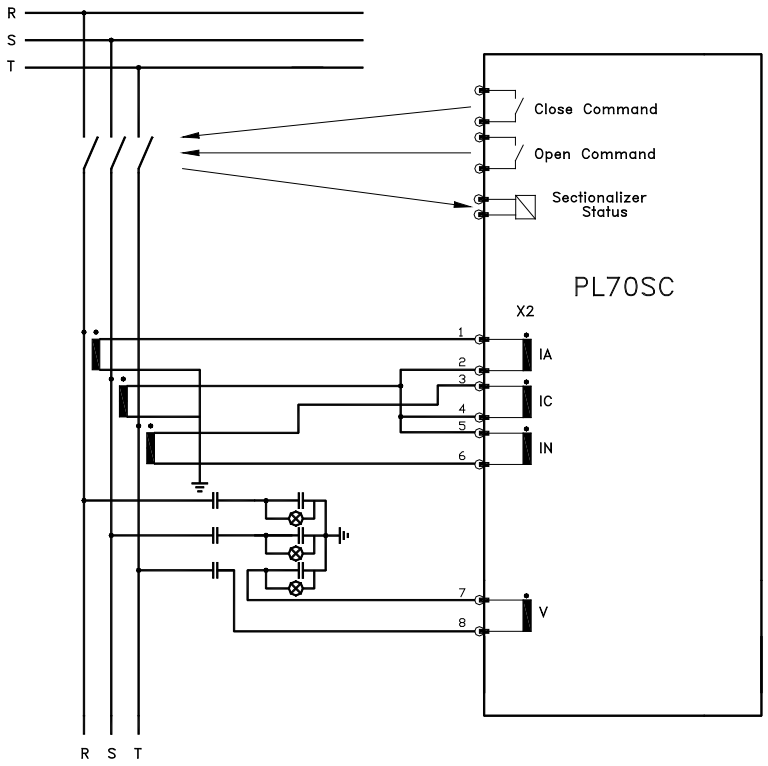
Voltage presence detector

Three hardware options are available for detecting voltage presence:

Digital input programming: "Voltage presence" or "Relay CAPDIS 1" and "Relay CAPDIS 2".

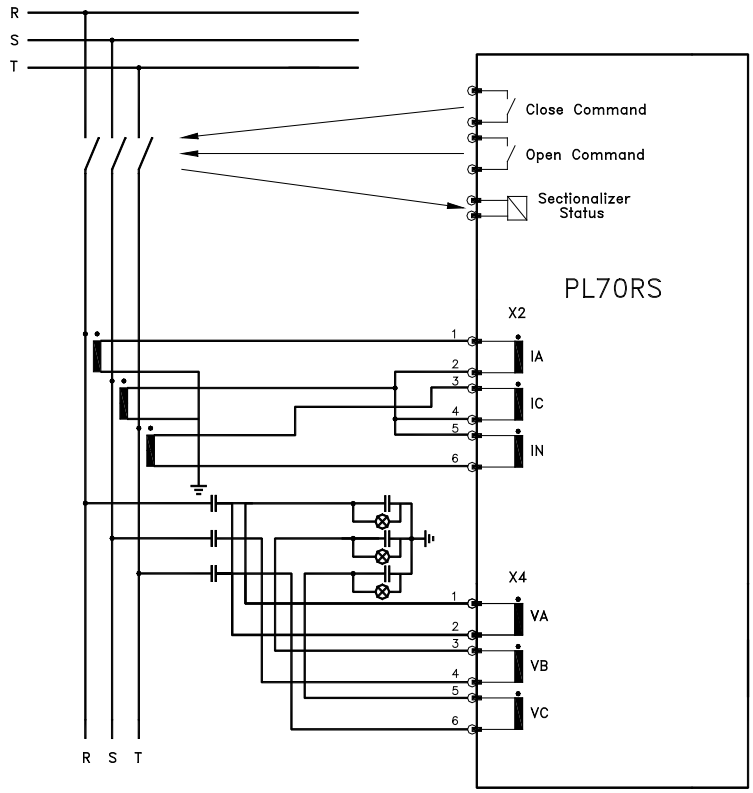
Conventional voltage input (Vn = 110/125Vac)

Input adapted for the measurement provided by the **capacitive splitter**. A more economic solution than the use of conventional VTs



PL70SC connections with input for capacitive splitter

(only certain of the DIs and DOs available in the unit are shown).



PL70RS connections with input for capacitive splitter

(only certain of the DIs and DOs available in the unit are shown).

The voltage presence detection functions as an additional security element to the fault detection and selector automatism. However, a fault in the detection function does not invalidate its functioning, given that the presence of current impedes the execution of the breaking command.

A failure in the presence signal (for example, as a result of a broken capacitive splitter) may be supervised using the "V abs. with I pres. anomaly" signal, which indicates a lack of voltage with the presence of current – a situation which is indicative of a problem in the voltage circuit - in a phase or in the neutral.

Digital Inputs

There are two options for determining the detection of voltage presence by means of programmable digital inputs:

- Programming of the "Relay CAPDIS 1" and "Relay CAPDIS 2" digital inputs. Both inputs must be programmed, otherwise a user configuration fault will be registered and the associated internal logic will not function. The interpretation of the digital inputs is shown below:

  "Relay CAPDIS 1" ON and "Relay CAPDIS 2" ON: Absence of voltage in one or two phases.
  "Relay CAPDIS 1" ON and "Relay CAPDIS 2" OFF: Voltage presence.
  "Relay CAPDIS 1" OFF and "Relay CAPDIS 2" ON: Absence of voltage in the three phases.
  "Relay CAPDIS 1" OFF and "Relay CAPDIS 2" OFF: Capdis failure.

- Programming of "Voltage presence" digital input. The interpretation of this digital input is shown below:

  1. "Voltage presence" OFF: Absence of voltage in the three phases.

2. "Voltage presence" ON: Voltage presence.

The following priority levels have been established to determine voltage presence.

1. **"Relay CAPDIS 1" and "Relay CAPDIS 2" digital inputs.**
2. **"Voltage presence" digital input.**
3. **Conventional voltage capacitive splitter input.**

Measurement corrections

This function only applies to models with voltage measurement with an input for a capacitive splitter (PL70SC and RS bushing insulator).

Each measurement has a correction factor, which multiplies the measurement in order to correct any differences between the different sensors and, in the case of voltage, the bushing insulators and signalling circuits.

In the case of RS, there are three voltage factors, one for each phase.

Setting	Minimum	Maximum	Step	Remarks
Voltage factor	0,2000	1,8000	0,0001	SC family (Models B and D)
Phase A voltage factor	0,2000	1,8000	0,0001	RS family
Phase B voltage factor	0,2000	1,8000	0,0001	RS family
Phase C voltage factor	0,2000	1,8000	0,0001	RS family

The unit is equipped with a further Setting: Bushing insulator capacity, which must be set in accordance with the capacity of the bushing insulator to which it is to be connected. If an incorrect setting is employed, the voltage measurement will be affected.

Setting	Minimum	Maximum	Step	Remarks
Bushing insulator capacity (pF)	3,0	35,0	0,1	

In the event of the bushing insulator's capacity not being known, the defect value 20 pF should be employed. In a given installation in which a 20 pF setting measures V (kV), a change in the setting to C pF will result in the measurement being multiplied by 20/C, that is to say, if the setting is programmed at 10 pF, the measurement will be doubled.

A more precise measurement is obtained with the correction factor. If, for example, the measurement is 24 kV when it should be 22, a voltage factor of 22/22 = 0.92 should be programmed.

The same is applicable to currents: if a measurement of 580 A instead of 600 A is obtained in phase C, the "phase C factor" should be set at 600/580 = 1.03

A specific setting indicates if xenon lights have been connected. When lights are connected, the measurements are corrected.

Setting	Minimum	Maximum	Step	Remarks
Light correction				XENON/NO

In PL70RS units with voltage measurement and capacitive splitter input, voltage is calculated using the current circulating through a capacitive circuit. Due to the characteristics of the capacitive circuits, a phase difference is entered between the current circulating through the circuit and the voltage to be measured. This phase difference is compensated with the "lead/lag adjustment" setting.

Setting	Minimum	Maximum	Step	Remarks
Angle correction (deg.)	0,0	359,9	0,1	

These settings can be found in the "Programmable factors and bushing insulators" screen in the Console.

Phase current passover detection

General description

Fault passover detection for 2 phases (phase A and C), with the following selectable characteristics:

Timed characteristic

Normal inverse time. (I BSC or I ANSI)

Short inverse time (IL BSC)

Long inverse time (IL BSC)

Very inverse time. (MI BSC or MI ANSI)

Extremely inverse time. (EI BSC or EI ANSI)

Special very inverse time (MIEs BSC)

Moderately inverse time (ANSI)

User curve (USUAR 1)

Definite time

Instantaneous characteristic

Instantaneous element

Additional time

Timed characteristic settings range

Setting	Min	Max	Step	Remarks
Phase fault passover detection enabling				YES/NO
Phase fault passover detection pick up (A)	0,015 0,003	3,000 3,000	0,001 0,001	Models A and B Models C and D
Curve type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,00	600,00	0,01	

These settings can be found in the "DPF cut-out organs protection" screen in the Console.

If the Enable setting is set at YES, the function can consider the existence of a fault. If it is set at NO, the function is not activated. This is common to the timed fault passover detection functions.

The start-up current is set in Amperes in the secondary.

When working with definite times, once the unit registers a current in one of the phases that is greater than the pick up setting during a period equal to or greater than the setting, the unit considers that there is a fault and starts all the logic inherent to the fault passover detection, as explained in "General fault passover detection settings" section.

Should the fault disappear and the current in A and C and Neutral fall below 1% of the setting (or a definite noise threshold, whichever is greater), the T. Fault Memory time will be counted down. If there is no voltage presence or current in any phase or in the neutral upon the conclusion of this period, timed phase fault passover detection is signalled.

When working with curves, the time the unit takes to consider the existence of a fault depends on the selected curve (family and index) and the current value. The normal, very inverse, extremely inverse and user curves can be selected as corresponding to the BS142 (IEC 255-4) standard or ANSI. Appendix II contains graphics and formulas for the calculation of the time in accordance with the quotient between the current and the pickup current. If the quotient is higher than 40, 40 is taken for the calculation.

Instantaneous characteristic settings range

Setting	Minimum	Maximum	Step	Remarks
Phase fault passover detection enabling				YES/YES+INRUSH/ NO
Phase fault passover detection pick up (A)	0,015 0,003	3,000 3,000	0,001 0,001	Models A and B Models C and D
Definite time(s)	0,00	60,00	0,01	

These settings can be found in the "DPF cut-out organs protection" screen in the Console.

If the Enabling setting is set to YES+INRUSH, the function can consider the existence of a fault when no inrush is detected by means of the harmonic analysis of the waveform: If it is set to YES, the unit may consider the existence of a fault regardless of the inrush. If it is set to NO, the function is not activated. This is common to the instantaneous fault passover detection functions.

The start-up current is set in Amperes in the secondary.

Once the unit registers a current in one of the phases that is greater than the pick up setting and, furthermore, no inrush is detected by means of the harmonic analysis of the wave form within a time equal to or higher than the setting (when the enabling setting is set to YES+INRUSH – to the contrary, the inrush is disregarded), the unit considers that there is a fault and starts all the logic inherent to the fault passover detection, as explained in the "General fault passover detection settings" section.

Should the fault disappear and the current in A and C and Neutral fall below 1% of the setting (or a definite noise threshold, whichever is greater), the T. Fault Memory time will be counted down. If there is no voltage presence or current in any phase or in the neutral upon the conclusion of this period, instantaneous phase fault passover detection is signalled.

Neutral fault passover detection

General description

In neutral earthed installations, this provides neutral fault passover detection with the same characteristics options as those described for phases, as well as independent settings.

Timed characteristic settings range

Setting	Min	Max	Step	Remarks
Neutral fault passover detection enabling				YES/NO
Neutral fault passover detection pick up (A)	0,008 0,002	3,000 2,000	0,001 0,001	Models A and B Models C and D
Curve type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,00	600,00	0,01	

e settings can be found in the “DPF cut-out organs protection” screen in the Console.

The remarks on curves and accuracy in times are the same as those quoted for phases.

Instantaneous characteristic settings range

Setting	Minimum	Maximum	Step	Remarks
Neutral fault passover detection enabling				YES/YES+INRUSH/NO
Neutral fault passover detection pick up (A)	0,008 0,002	3,000 2,000	0,001 0,001	Models A and B Models C and D
Definite time(s)	0,00	60,00	0,01	

These settings can be found in the “DPF cut-out organs protection” screen in the Console.

Sensitive neutral fault passover detection

General description

This provides sensitive neutral fault passover detection with the same characteristics options as those described for phases, as well as independent settings.

The sensitive neutral fault passover detection function is effected on the neutral measurement.

Timed characteristic settings range

Setting	Min	Max	Step	Remarks
Sensitive neutral fault passover detection enabling				YES/NO
Sensitive neutral fault passover detection pick up (A)	0,008 0,002	3,000 2,000	0,001 0,001	Models A and B Models C and D
Curve type				Definite time Normal curve, very, extreme. Inverse, etc. User curve
Time index	0,05 0,5	1,09 30,0	0,01 0,1	For IEC curves For ANSI curves
Definite time(s)	0,00	600,00	0,01	

These settings can be found in the "DPF cut-out organs protection" screen in the Console.

The remarks on curves and accuracy in times are the same as those quoted for phases.

Instantaneous characteristic settings range

Setting	Minimum	Maximum	Step	Remarks
Sensitive neutral fault passover detection enabling				YES/YES+INRUSH/NO
Sensitive neutral fault passover detection pick up (A)	0,008 0,002	3,000 2,000	0,001 0,001	Models A and B Models C and D
Definite time(s)	0,00	60,00	0,01	

These settings can be found in the "DPF cut-out organs protection" screen in the Console.

General fault passover detection settings

Setting	Minimum	Maximum	Step	Remarks
Voltage presence level (V)	10,0 4000	270,0 45000	0,1 1	PL70 bushing insulator
Voltage absence level (V)	10,0 4000	270,0 45000	0,1 1	PL70 bushing insulator
Voltage presence/absence hysteresis level (%)	0.0	100	0.1	
Fault memory time (s)	0,0	100,0	0,1	
Minimum voltage presence drop off time (s)	0,0	1800,0	0,1	
Light signal drop off time (min.)	5	181		
Remote signal disabling passover time (sec.)	0	1801	1	

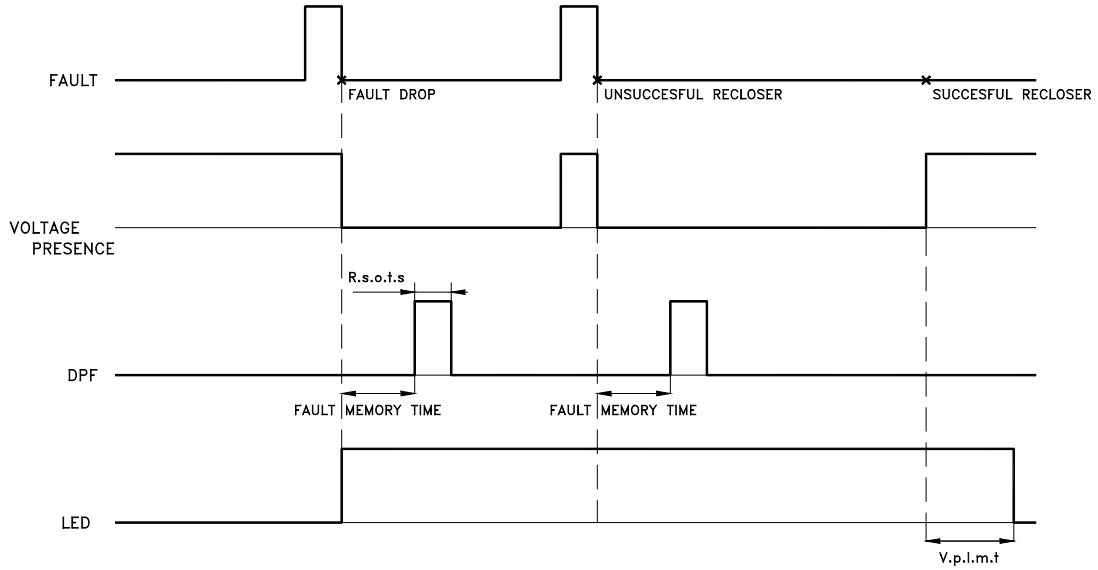
The voltage presence level setting is set in secondary values. It is the minimum voltage value for which the unit considers there is voltage within the system.

The voltage absence level setting is set in secondary values. It is the maximum voltage value below which the unit considers there is an absence of voltage within the system.

Programmable voltage presence/absence hysteresis (%). A single setting is used to indicate voltage presence and absence hysteresis in order to avoid unnecessary variations.

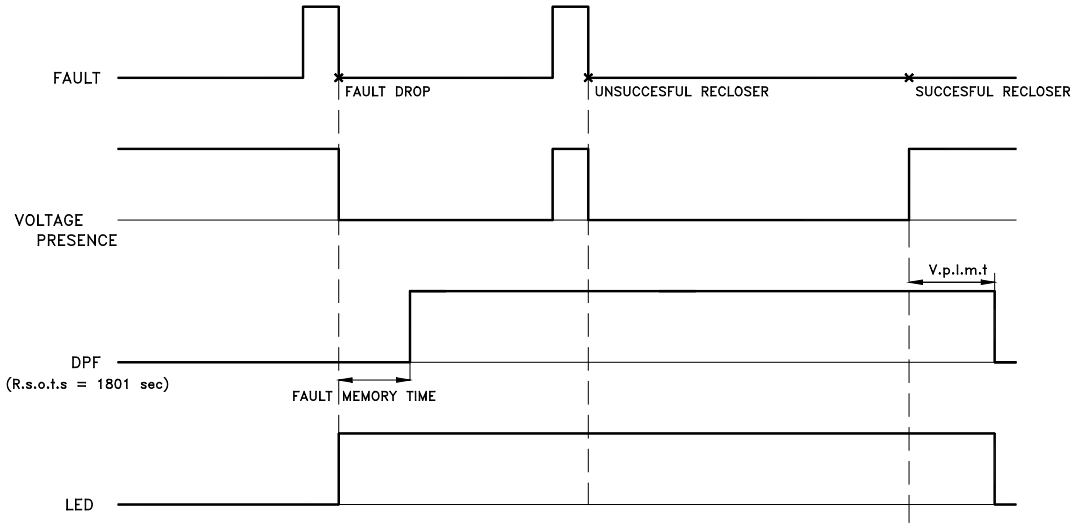
Remote passover disabled time signal (sec.) is the waiting time before the remote fault passover detection signal is disabled. If the setting is set to 1801 seconds, the signal is not deactivated once the set period has elapsed. It will only be deactivated once the system has successfully reclosed and there is voltage presence once more. Following the elapse of the **minimum voltage presence time**, the current passover due to fault detection is deactivated.

The fault passover detection function uses the programmed voltage presence input to verify voltage presence.



V.p.l.m.t = Voltage presence lockout minimum time (sec)
R.s.o.t.s = Remote signal off time step (s)

"Remote signal off time step" set has a different value to 1801 seconds.



V.p.l.m.t = Voltage presence lockout minimum time (sec)
R.s.o.t.s = Remote signal off time step (s)

"Remote signal off time step" set has a value of 1801 seconds.

The attached time diagrams shows 3 moments:

The moment in which the fault occurs

Unsuccessful reclosure

Successful reclosure

Fault memory time

This is the time elapsed as of the moment in which the fault drop out is detected (when the current drops below 1% of the pickup setting) until the DPF signal, which is transmitted to the breaker automatism, is activated (next section). If there is voltage presence upon the expiry of this period, the DPF signal is not activated.

The LED (corresponding to the *phase or neutral fault signalling* programming) is activated as of the moment the start of the first fault. It can be deactivated when in the following cases:

- the **voltage presence minimum time** has elapsed; once the system has been successfully reclosed and there is voltage presence again, the LED is deactivated following this period.
- If the system is not restored (in which case there would be no voltage presence), this luminous signal is deactivated once elapsed the time programmed in the **luminous signal restoration time** setting**.**
- If this setting is programmed at 181 minutes, the luminous signal is not deactivated when this time elapses. In such a case, the signal is deactivated manually by simultaneous pressing the permission ("·") and automatism ("A") keys.

If the digital input programmed as "rearm" is activated.

Passover due to fault simulation

The unit's front board has four buttons, labelled "I", "O", "·" (permission) and "A/M" (Automatic/Manual). By pressing "I" for 2 seconds, the unit activates the signals related to the passover due to fault algorithm for 1 second, thus enabling the unit's operation to be checked.

1.50 FAULT PASSOVER DETECTION DIRECTIONALITY

The fault passover detection functions can be directional in the RS family.

In such a case, each of the functions (timed and instantaneous) has an additional setting, "Torque control", which if set FORWARD or REVERSE indicates that the function is to act as directional (in either of the direction). If set to NO it acts as NON DIRECTIONAL.

The settings corresponding to the directionality criteria are found in the "Overcurrent protection (3)" screen. The options are shown below, followed by descriptions of the functions.

Phase direction criterion. Applicable in the phase directional function (67). Options: "Quadrature" or "No".

Phase lead/lag (degrees). Programmable between 0º and 360º. Applicable in the phase directional function (67).

Neutral directional type. Can be set as "Angular criterion" or "No".

Neutral directional criterion. Applied in the neutral directional function when polarized by tension. The following neutral direction criterion is employed: S0 (zero sequence voltage polarization).

Neutral lead/lag (degrees). Programmable between 0º and 360º. Applied to the neutral directional function (67N) when the S0 neutral direction criterion has been selected.

V polarization. This is the minimum polarization voltage value, below which it is considered that the direction is not known with certainty.

Minimum Vn threshold. The minimum VN threshold must be exceed in order to permit the pick up of the neutral directional unit.

Trip permission without Vpol (in display, *Directional lock*) If set to YES, it enables fault passover detection if the polarization voltage is lower than the minimum polarization voltage; if set to NO, fault passover detection is not allowed under such conditions.

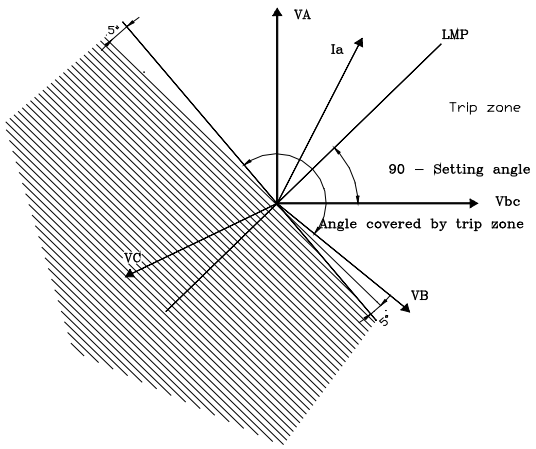
Phase zone amplitude and *Neutral zone amplitude*. These settings indicate the angle covering the phase and neutral units' trip zones, respectively. That is, if the maximum torque line is set to 0º and the amplitude of the pick zone to 70º, the relay trips between +35 º and -35 º. The lock zone is obtained by adding to 5º to each side of the zone. In this zone, the relay maintains the latest status registered (forward or reverse). That is, if it comes from a trip zone, the trip is maintained until the lock zone is crosses. If it comes from a no-trip zone, it is maintained without a trip until the zone is crossed.

If, for example, the trip zone is to be between -40º and 130º, the "setting angle" must be set at 45º and the "covered angle" at 170º.

Quadrature phase direction (67)

Operation

For the detection of directionality in phases, the polarization voltage corresponds to the quadrature connection (90º), in which the each phase's current is compared with the phase to phase voltage between the other two phases.



Phase directional

It operates as three single phase units in which polarization voltages are the phase to phase to voltages of the healthy phases.

The phase to phase voltages are obtained from the calculation of the phase to earth voltages.

In the case of a ABC *phase sequence*, polarization is effected with Vab and Vbc, instead of Ic and Ia. In the case of a CBA *phase sequence*, polarization is effected with Vba and Vcb, instead of Ic and Ia.

The phase b current is calculated with In, Ia and Ic.

There is a 5° zone between the non-trip zone and the trip zone in which the current directional status is maintained.

Memory

Polarized by the positive sequence voltage whilst it exceeds a threshold. If the voltage is below this value, polarization is effected by the voltage that was memorized 2 cycles prior to the disappearance of the voltage. This memory is maintained for 0.5 seconds.

Trip permission without Vpol (in display, Directional lock)

The setting is used when the polarization voltage falls below the threshold (V polarization setting), which when set to YES indicates forwards (trip permission) and when set to NO indicates reverse (no permission).

The memory is treated prior to this.

Signals

Provides forward and reverse signs per phase. (Forward, Reverse).

When the Trip permission without Vpol (directional lock) is set to "NO" and the polarization magnitudes are below the threshold, the direction is not signalled.

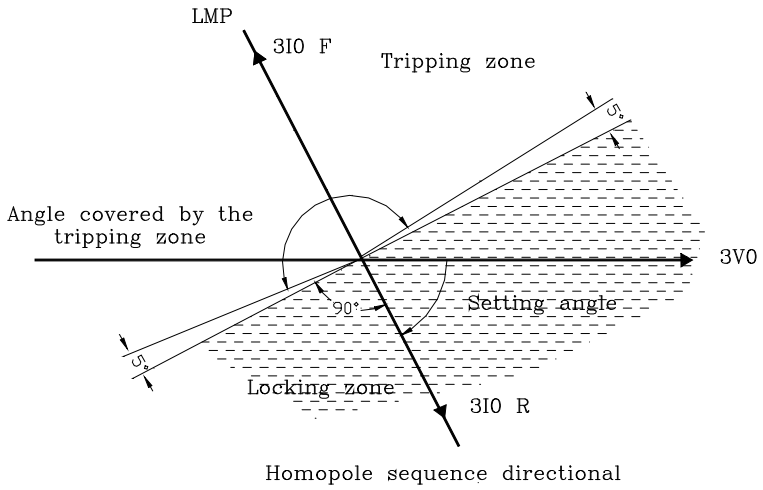
When the Trip permission with Vpol (directional lock) is set to "YES" and the polarization magnitudes are below the threshold, it signals forward and reverse.

Neutral directional (67N); polarization by SO (VO)

Operation with polarization by VO, zero sequence voltage

The direction is determined using the neutral current (3·I0) with the neutral voltage as polarization, (3·V0). The angle determines the range in which the fault is considered as a forward fault and as a reverse fault. A forward fault is recognised in accordance with the following:

90-lead/lag setting<arg(I0)-arg(V0)<270-lead/lag setting



Homopole sequence directional

There is a 5° zone between the non-trip zone and the trip zone in which the current directional status is maintained.

The 3V0 measurement is obtained from the calculation of the phase to earth voltages.

Trip permission without Vpol (in display, Directional lock)

The setting is employed when the polarization voltage (3·V0) falls below the threshold (V polarization setting), which when set to YES indicates forwards and when set to NO indicates reverse.

Signals

Provides forward and reverse signs. (Forward, Reverse).

When the Trip permission without Vpol (directional lock) is set to “NO” and the polarization magnitudes are below the threshold, the direction is not signalled.

When the Trip permission with Vpol (directional lock) is set to “YES” and the polarization magnitudes are below the threshold, it signals forward and reverse.

1.51 BREAKER MONITORING

General description

This function causes an "event" and a control signal in the event of a number of trips higher than the programmed value during the programmed time and changes to a definite trip. The period is reset upon a manual closure.

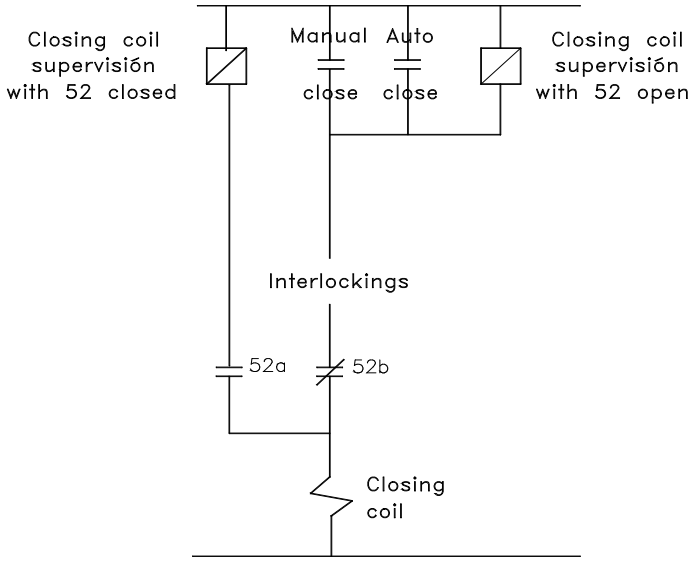
An event is also generated each time the ∑kI2 meter exceeds the programmed threshold following a trip. While in this situation, the corresponding signal is sent to control.

Settings range (4 tables)

Setting	Minimum	Maximum	Step	Remarks

Excessive number of trips	1	254	1	
Time span for number of trips (sec.)	300	3.600	1	
ΣkI2 alarm threshold	0	65.535	1	
Initial ΣkI2 value	0	65.535	1	
Trip circuit monitoring enabled				YES/NO
Circuit closure monitoring enabling				YES/NO

Coil monitoring example



The trip coil's connections should be similar.

The relays programmed as "closure circuit fault" or "trip circuit fault" are activated 20 seconds after the fault is detected, in the event of the fault persisting upon the conclusion of this period.

The coil monitoring function is only available in models equipped with a digital I/O extension board. In order for this function to operate correctly, the breaker status must be cabled.

1.52 OPERATING LOGIC

General description

Trip sealing: if set to "YES" when a trip signal is produced, the trip contact sealing remains active until it detects the opening of the breaker, even in the event of the current having disappeared. If it is set to "NO", the trip signal disappears when the current falls below the pick-up current (nevertheless, the relay is guaranteed as excited for at least the period programmed in the digital output programming).

The opening and closure failure time settings determine the time lapse between the issue of the corresponding command and the reception of the breaker's activity signal, on the understanding that the breaker has acted correctly. If not, an "event" and a control signal are activated. Furthermore, one relay is activated (in the event of a relay having been programmed in relation to this function) for the opening fault and another for the closure fault.

Settings range (4 tables)

Setting	Min	Max.	Step	Remarks
Trip sealing				YES/NO
Breaker opening fault timing (sec.)	0,020	15,000	0,005	
Breaker closure fault timing (sec.)	0,020	15,000	0,005	

1.53 BREAKER FAILURE PROTECTION

General description

Output relays can be programmed as:

Breaker closure fault. Monitors the "52 status" input.

Breaker opening fault. Monitors the "52 status" input.

Breaking fault with overcurrent. It functions in accordance with the settings group generically known as "Breaker fault":

Enabling of the function

Phase drop off current

Neutral drop off current

Definite time

When enabled, the function acts as follows: if the unit issues a trip signal or receives an external protection signal via a digital input, the timer will pick-up. If, following the programmed “definite time”, the current in any of the phases is superior to the programmed “phase drop off current” or if the neutral is superior to the programmed "neutral drop off current", the relay which has been programmed as "overcurrent breaker fault" is activated. The relay is deactivated when the phase and neutral currents fall below their drop off values.

If a LED has been programmed as "Breaker fault (Breaker fault with overcurrent)", it will be activated in the same way as the relay, although it will only be deactivated through the keyboard/display in "Last fault", as the LEDs which signal trips.

The external protection signal is memorized internally, that is to say, it may be a pulse.

This manner of functioning does not contemplate the breaker status digital input, but rather the current values.

Settings range (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Enabling				YES/NO
Phase drop off (A)	0,1	100,0	0,01	
Neutral drop off (A)	0,02 0,005 0,1	20,0 5,000 100,0	0,01 0,001 0,01	IS/IT/RT families(Models C and D) IS families (Models A and B) Other families
Definite time (sec)	0,0	60,00	0,01	

These settings can be found in the Console on the “Overcurrent protection (2)” screen.

1.54 BREAKER FAILURE PROTECTION (TRIP DUE TO FAULT)

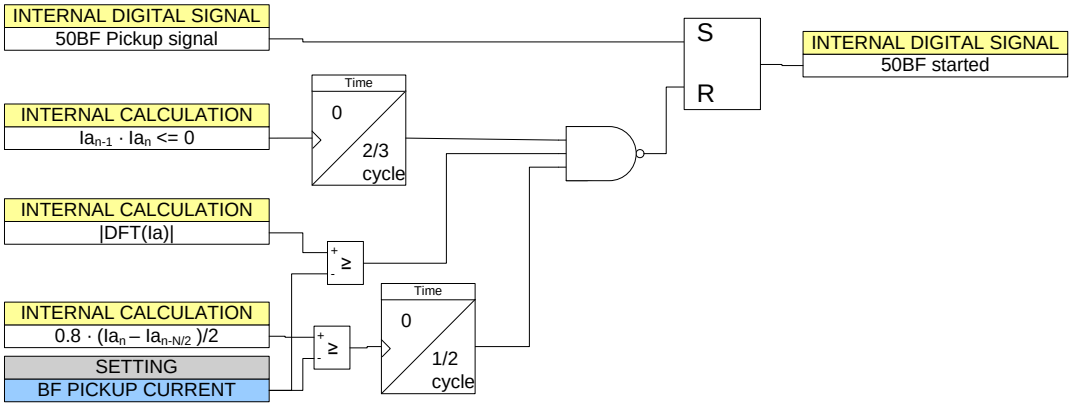
Specific function for the PL70FI model.

This signal’s drop off is produced in less than 20ms. The following is employed:

The DFT drop out without delay.

If the instantaneous current (sample differences separated by N/2) does not exceed 80% of the threshold during one ½ cycle, the function is also reset.

The zero register of the phase currents. If phase currents do not register zero in a period inferior to 2/3 of the cycle, the pick up is eliminated.



Settings

A setting defines the enabling of the function:

Disabled

Enabled only for external trips

The operation mode can be selected by means of a setting:

Three-pole, only via the EXTERNAL TRIP digital input (three-phase)

Three-pole, only via the EXTERNAL TRIP (three-phase) or EXTERNAL TRIP A, B, C (single-phase) digital inputs

Single-pole, only via the EXTERNAL TRIP A, B, C (single-phase) digital inputs

Single-pole, via the EXTERNAL TRIP (three-phase) or EXTERNAL TRIP A, B, C (single-phase) digital inputs; differentiated from the three-pole by the outputs it gives.

Another setting is employed to define whether the disappearance of the trip signal is to cause the drop out of the function (memorized trip). That is, if the trip signal is to be permanent or whether a pulse is sufficient. Trip signal:

Pulse

Permanent

Another setting defines if the monitored breaker is independent or if it is combined with others (breaker-and-a -half or ring topologies). Topology 52:

Independent

Combined. In this case, the current travelling to a breaker (even when the breaker has not opened) cannot exceed the programmed drop off threshold until the breaker opens.

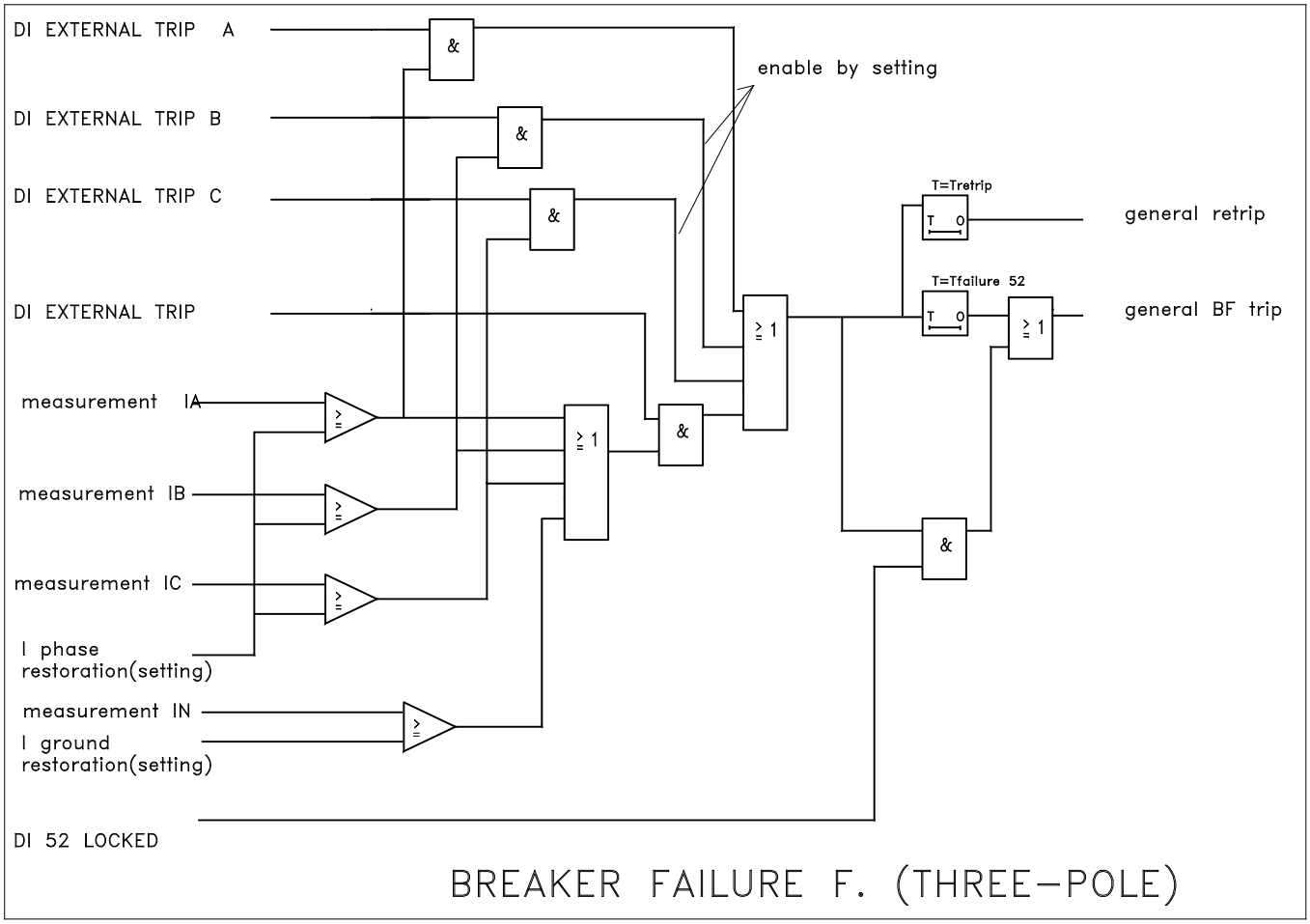
Timings:

Retrip: 0 to 60 s, step 0.001 s

BF trip: 0 to 60 s, step 0.001 s

Drop off current (phases and neutral): 0.1 to 100 A, step 0.01 A.

Three-pole operation

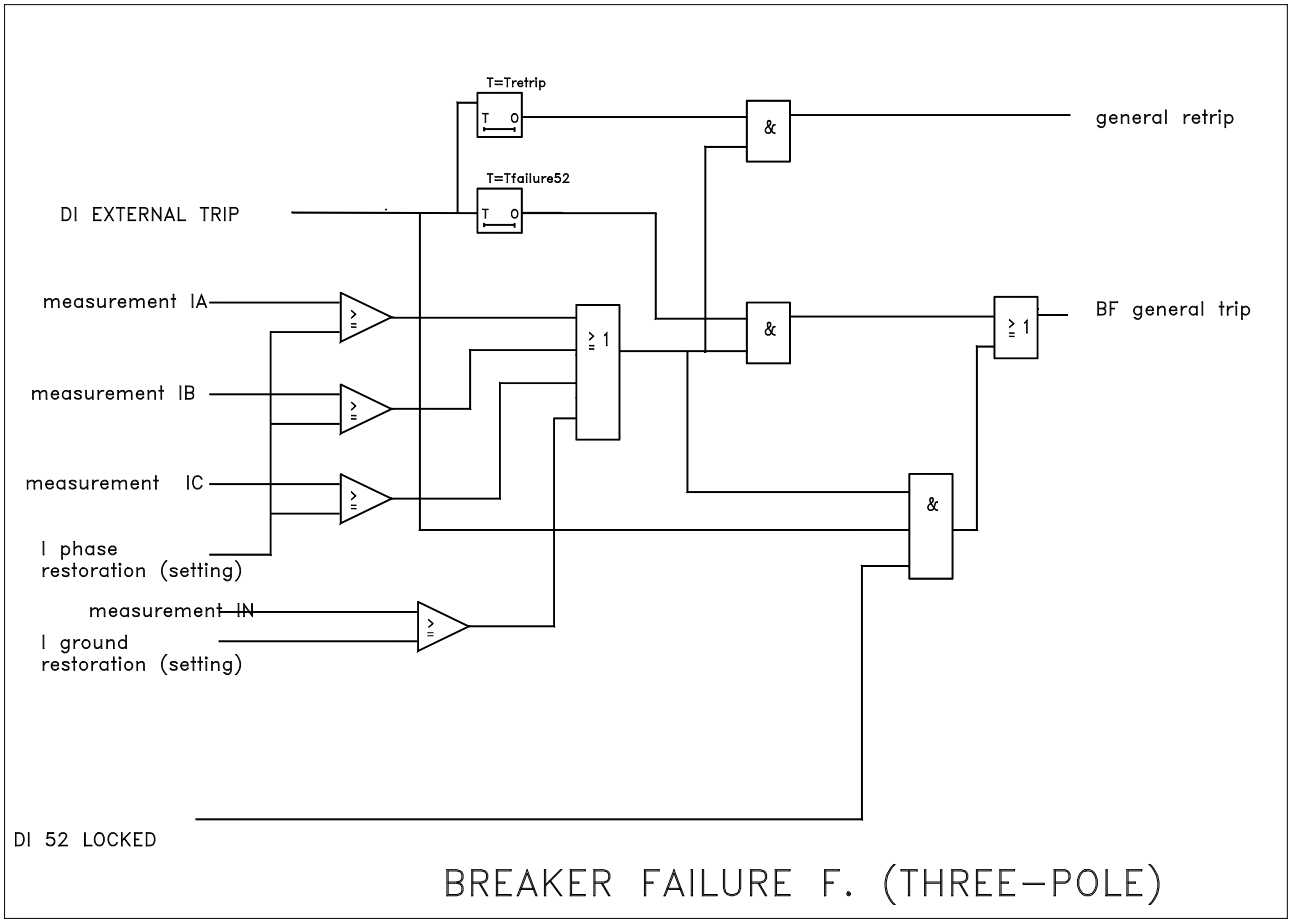


Case 1. Three-pole, activation by general or single-phase, pulse, 52 independent

In this case, the picked up timers only drop off when all the currents drop off.

Case 2. Three-pole, activation by general or single-phase, permanent, 52 independent

In this case, the picked up timers only drop off when all the currents or the trip signal drop off.



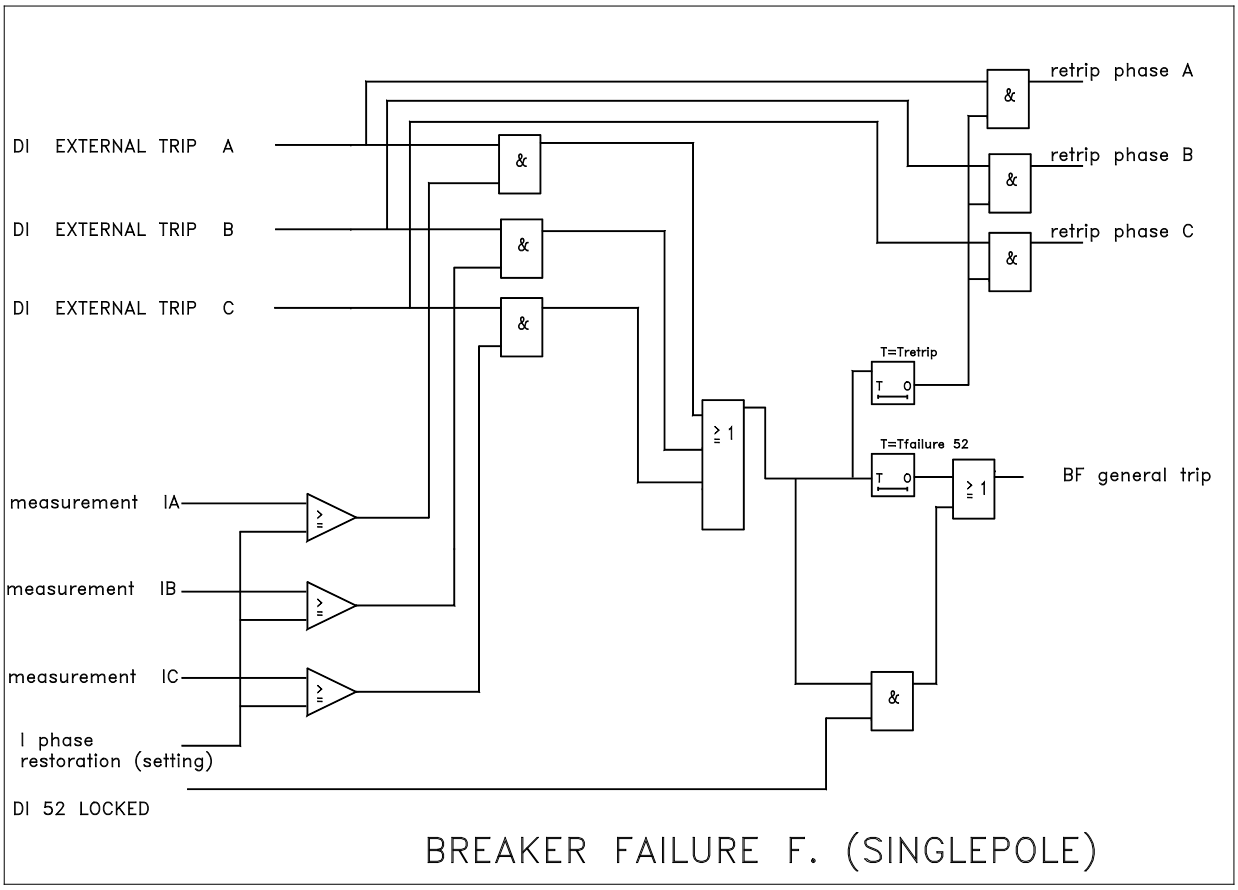
Case 3. Three-pole, activation only by general, pulse, 52 independent.

In this case, the picked up timers only drop off when all the currents drop off.

Case 4. Three-pole, activation only by general, permanent, 52 independent.

In this case, the picked up timers only drop off when all the currents or the trip signal drop off.

Single-pole operation



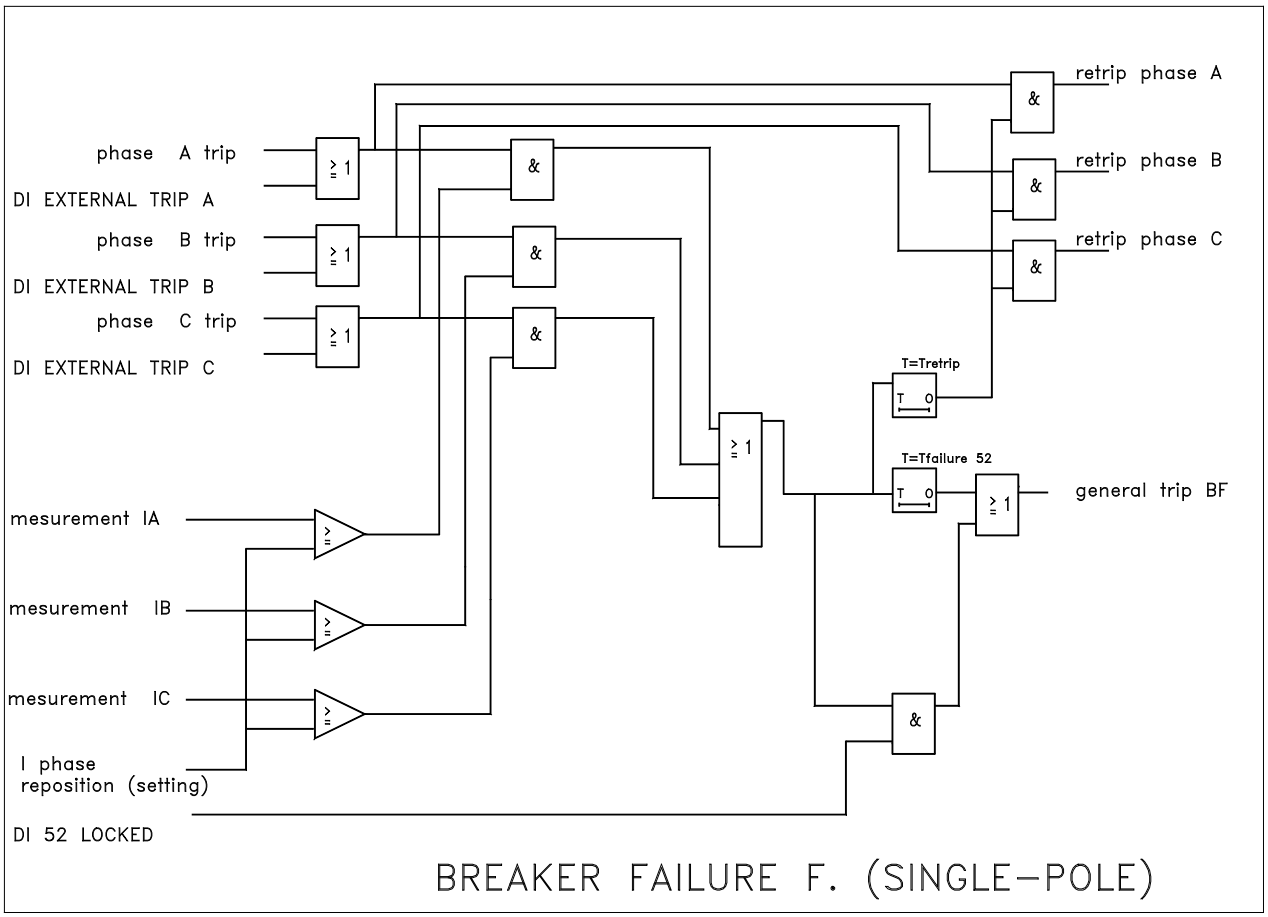
Case 5. Single-pole, activation by general or single-phase, pulse, 52 independent

In this case, the picked up timers only drop off when all the currents drop off.

If the cause of the activation is general, the retrip is applied over the three phases.

Case 6. Single-pole, activation by general or single-phase, permanent, 52 independent

In this case, the picked up timers only drop off when all the currents or the trip signal drop off.

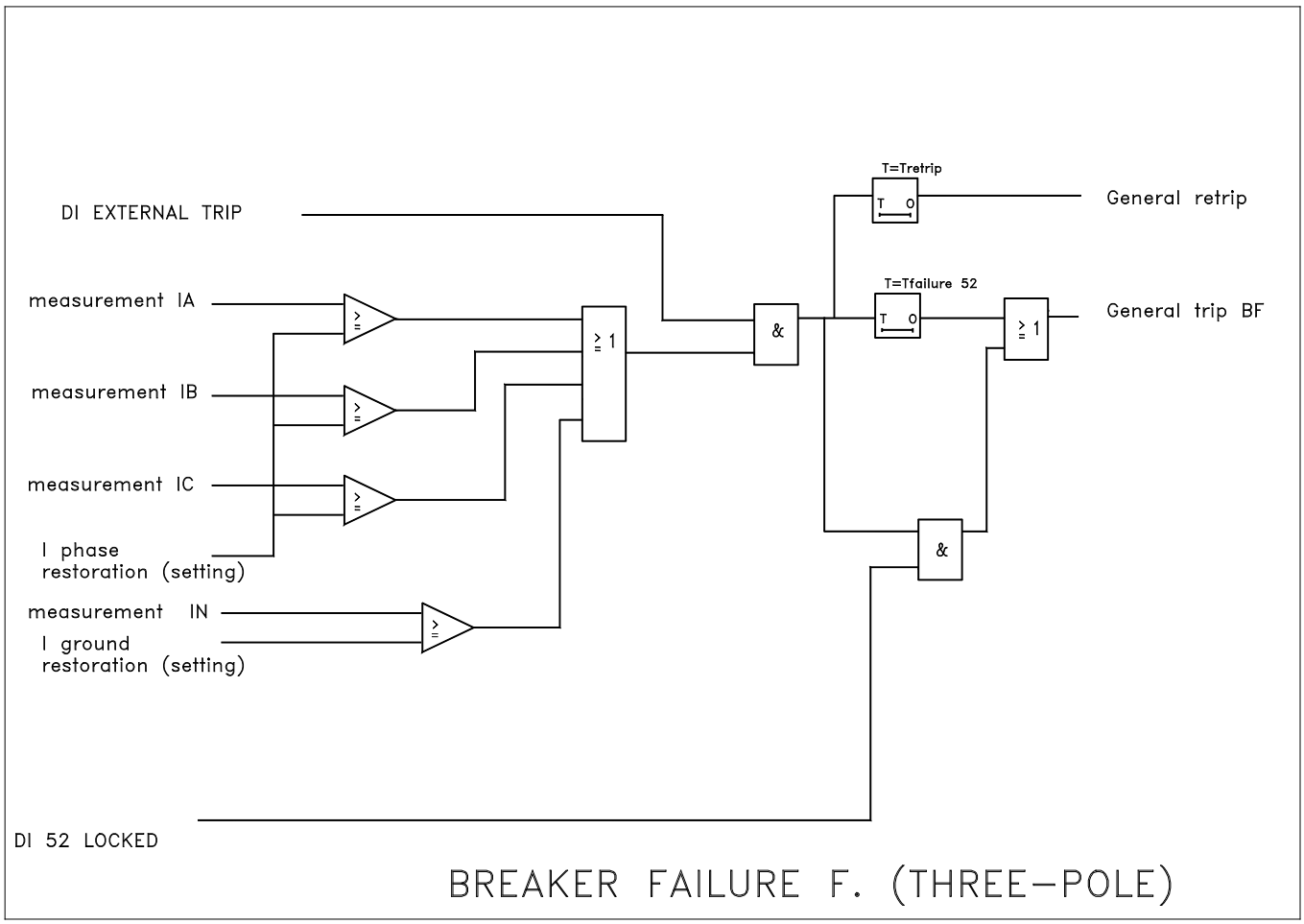


Case 7. Single-pole, activation by single-phase, pulse, 52 independent

In this case, the picked up timers only drop off when all the currents drop off.

Case 8. Single-pole, activation by single-phase, permanent, 52 independent

In this case, the picked up timers only drop off when all the currents or the trip signal drop off.



Case 9. Three-pole, activation only by general, pulse or permanent, combined.

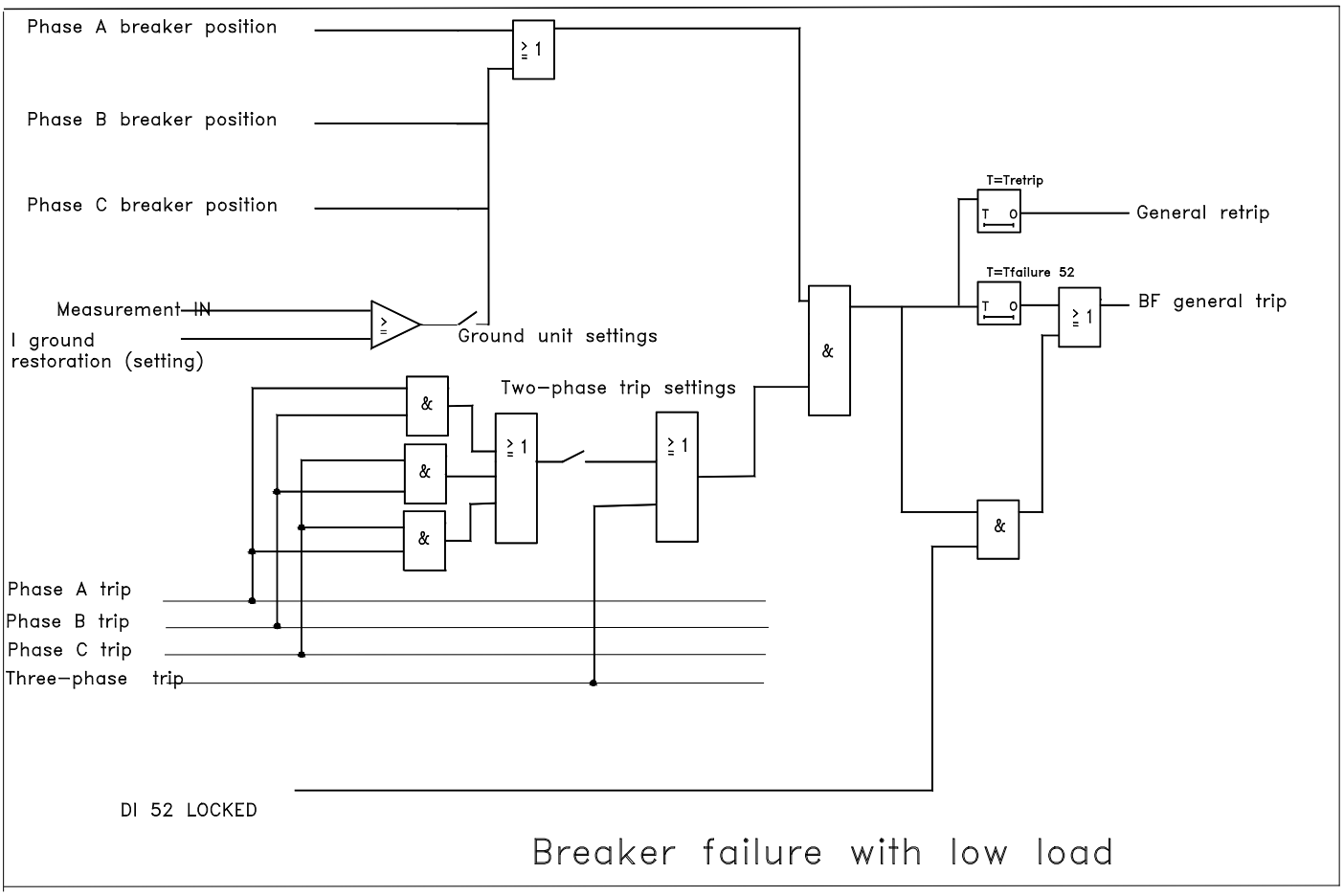
In the cases of “combined” breaker topology, the timers start as soon as the signal appears. Depending on whether the signal is permanent or pulse, the timers drop off or not when the signal disappears.

Remarks:

The logics of all the possible combinations are not shown, since it is assumed that the options are clear enough. However, in case of doubt, contact Ingeteam Technology SA.

The effect of input “52 locked”, when applicable, in any of the cases is to eliminate the timings in order to immediately provoke a general trip when the currents exceed the drop off threshold.

Breaker failure with low load or neutral



Name	Description	Range
CB1	Breaker fault with low load enabling	YES/NO
CB2	Two-phase trip permission:	YES/NO
CB3	Neutral detection unit enabling	YES/NO
CB4	Neutral current threshold:	0.1A -100 A
CB5	Retrip time with low load	0-60s / step 0.001 s
CB6	Retrip time with low load	0-60s / step 0.001 s

It picks up if:

The breaker contacts (setting to choose N/O or N/C) indicate closure (any pole, one is sufficient) or that the neutral current threshold is exceeded (CB4), when enabled (CB3)

A three-phase trip is received via a DI or a trip in at least tow phases is received via a DI (if the CB2 two-phase trip permission setting is set to YES).

It trips if:

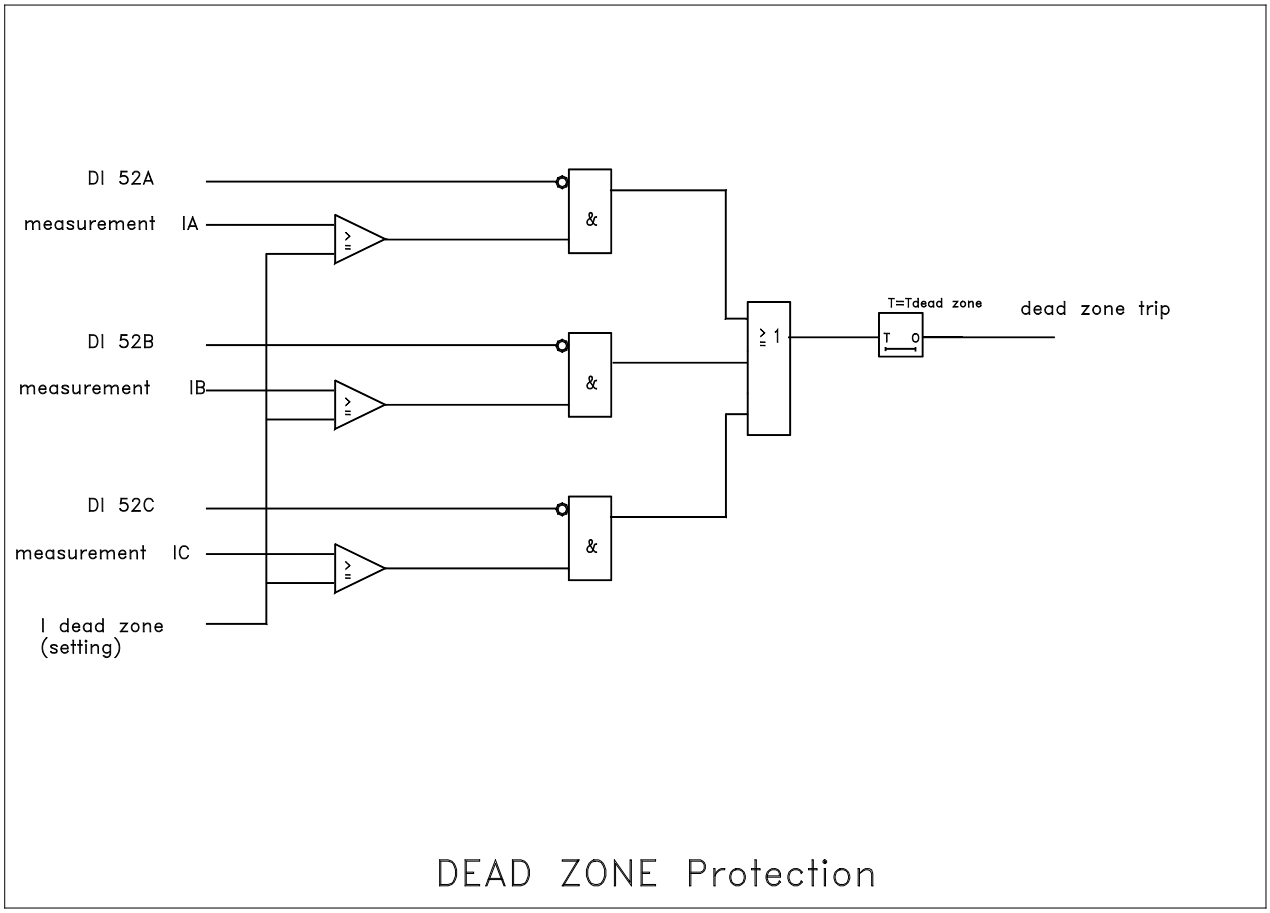
None of the pick up conditions disappear once having elapsed the set time (CB6).

It retrips if:

None of the pick up conditions disappear once having elapsed the set time (CB6).

The Pole discrepancy function is used to determine the breakers' status. If the pole discrepancy detects a fault (the N/O and N/C contacts are simultaneously active and inactive in a pole following the fault time), this breaker fault functions locks and no trip or retrip is produced.

End fault protection



When a pole is open and the corresponding phase current is higher than the setting, the breakers associated to the end fault are sent a trip signal.

The "52-Breaker Status" input (GENERAL DI), when programmed, prevails over the phase signals.

Timings:

End fault: 0 to 1 s, step 0.001 s

End fault threshold: 0.1 to 100 A, step 0.1 A.

Breaker failure upon opening with load

A setting defines the enabling of the function:

Disabled

Enabled

The operating mode (three-pole, single-pole) is the same as that defined for faults before a trip (in fault).

The disappearance of the trip signal DOES NOT to cause the drop off of the function (memorized trip).

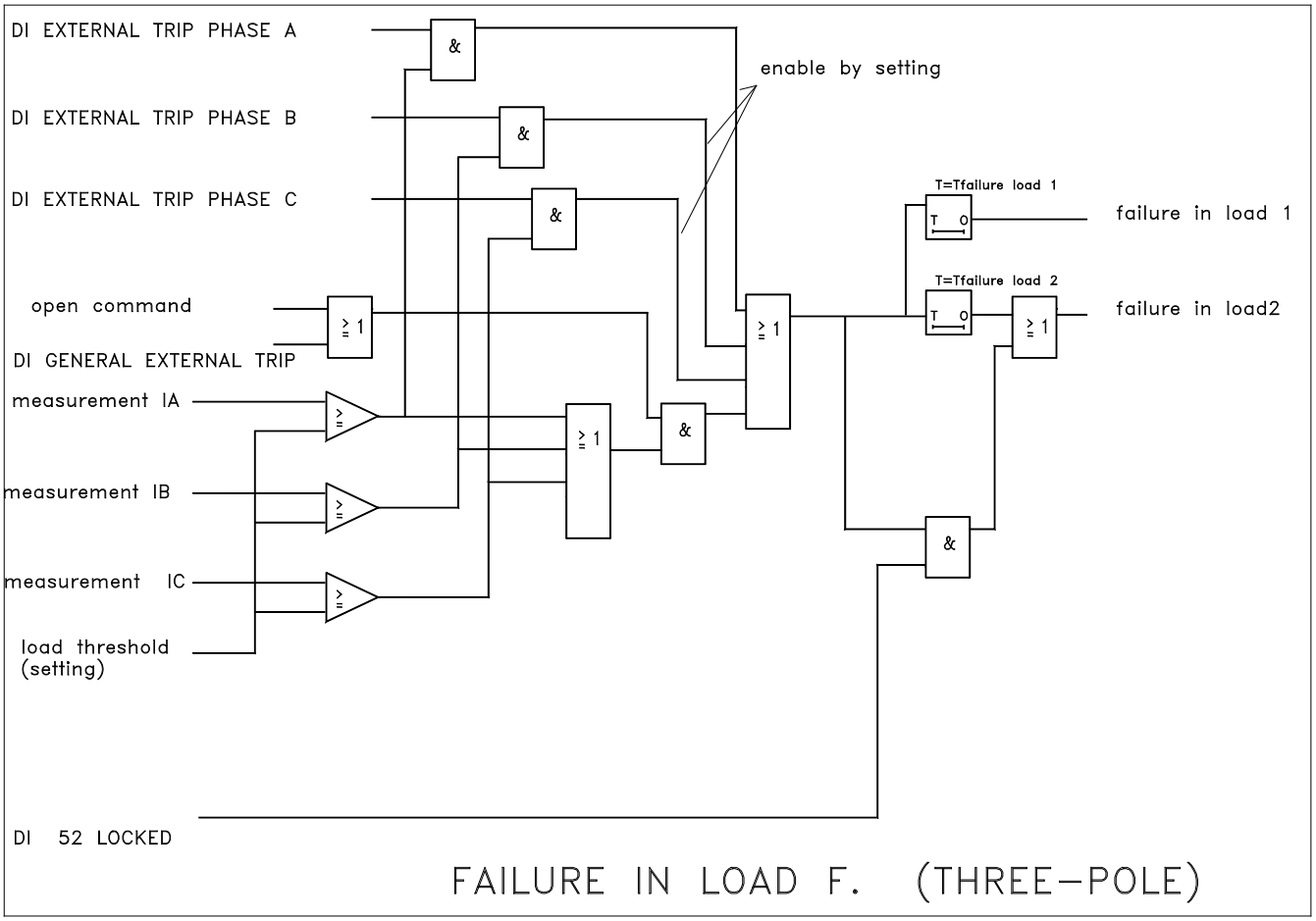
It functions the same as the fault failure, although with its own settings:

Load threshold: 0.1 to 10 A, step 0.1 A.

Timings:

Failure in load 1: 0 to 1 s, step 0.001 s

Failure in load 2: 0 to 1 s, step 0.001 s



Breaker failure upon closure

Settings:

Operating mode: three-pole or single-pole.

Failure upon closure time: 0.020 to 5 s, step 0.005 s

(both this setting and the failure upon opening time are to be found in the “Logic operation” screen).

If, in three-pole mode and following the issue of a closure command (for any cause) the “52 Status” DI remains open following the elapse of the programmed time, the "52 closure failure" signal is issued.

If, in single-pole mode and following the issue of a closure command (for any cause) the “52X (X = A, B or C) DI remains open following the elapse of the programmed time, the "pole A, B or C closure failure" signal is issued.

Flashover detection

The operating mode is defined by a setting:

By current only

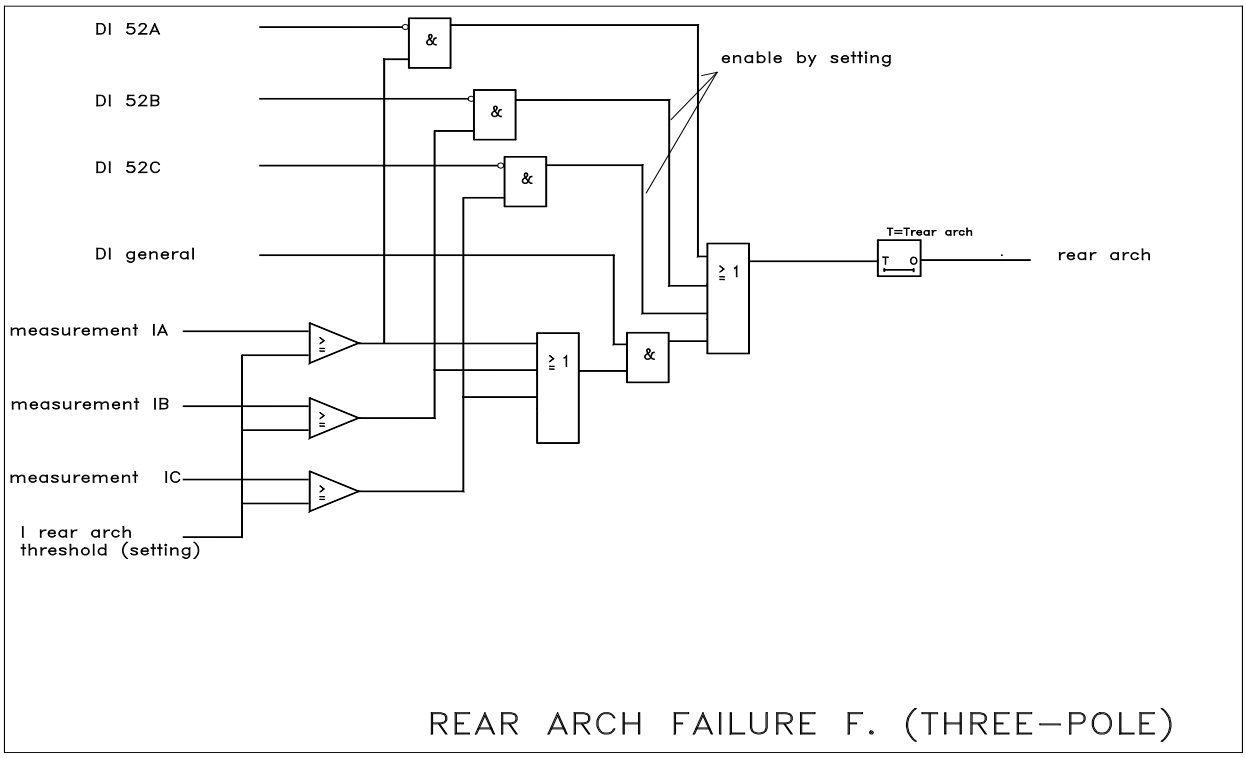
No (disabled)

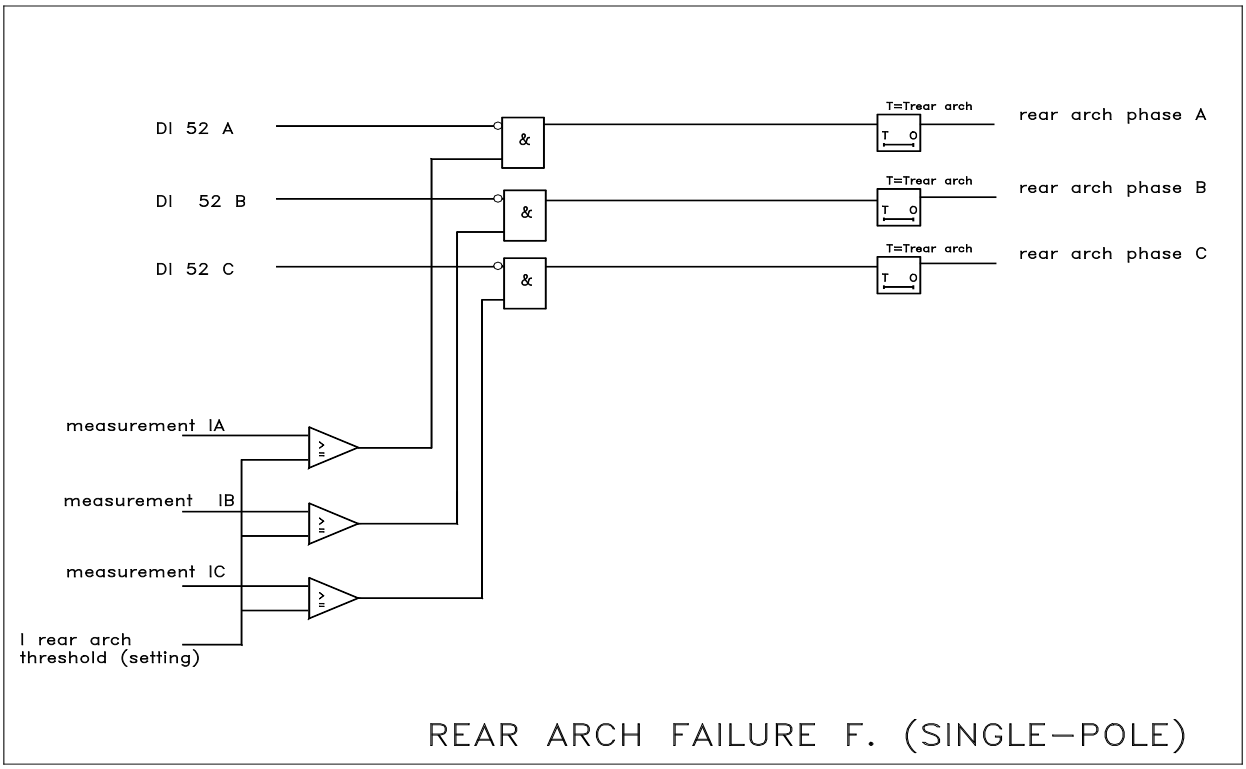
Flashover detection (current only)

Single-pole or three-pole functioning, as programmed in the breaker failure. If the contact indicates that the 52 is broken and that there is current, there is flashover.

Settings: flashover pick up: 0.05 to 100 A, step 0.01 A.

Flashover time: 0.01 to 1 s, step 0.01 s


DI 52A
DI 52B
DI 52C
DI general
measurement IA
measurement IB
measurement IC
I rear arch threshold (setting)
enable by setting
T=Trear arch
rear arch
REAR ARCH FAILURE F. (THREE-POLE)


DI 52 A
DI 52 B
DI 52 C
T=Trear arch
rear arch phase A
rear arch phase B
rear arch phase C
measurement IA
measurement IB
measurement IC
I rear arch threshold (setting)
REAR ARCH FAILURE F. (SINGLE-POLE)

1.55 PROTECTION FUNCTION LOCK

Each of the protection functions can be locked by a digital input or by a logical function (combination of inputs and/or control signals). See “Logical signal programming” in the Configuration section.

The lock is programmed via the keyboard/display as any other setting within the corresponding function.

By means of the Console, the lock is programmed via the “Locks” screen, with the number depending on the unit’s optional functions.

AUTOMATISM FUNCTIONS

1.56 RECLOSER

General description

The units allows up to 4 reclosures to be effected.

Different closure times for phase to phase and phase to earth faults.

Programmable safety period following manual closure and following automatic closure.

The 5 closure meters (total, first, second, third and fourth closures) are stored in non-volatile memory and can be viewed on the display. These meters can be set to 0 via the keyboard.

Definitions:

Surveillance or rest status.

This is the normal status, during which the recloser “monitors” for the occurrence of any trips. If any trips occur, the recloser is activated.

Current cycle status.

The status of the recloser while activated, from the first trip up to the closure of the breaker and the elapse of the safety period (successful reclosure), or until all the programmed reclosures have been unsuccessfully executed. In the first case, the recloser switches to “surveillance” and, in the second, to “definitive trip”

Definitive trip status.

The recloser’s final situation once it has run all the programmed attempts and the breaker remains open due to the existence of a permanent fault. It only abandons this status when the breaker is closed manually.

First, second, third and fourth closure.

The waiting time following the breaker trip until the recloser issues a closure order in each of the reclosure phases.

Safety period following manual closure.

The time following the manual closure of the breaker, during which the existence of a protection trip is monitored. In such a case, a definitive trip is triggered instead of a change to surveillance status.

Safety period following automatic closure.

The time following the automatic closure of the breaker during which the existence of a protection trip is monitored. In such a case, the cycle is continued instead of a change to surveillance status.

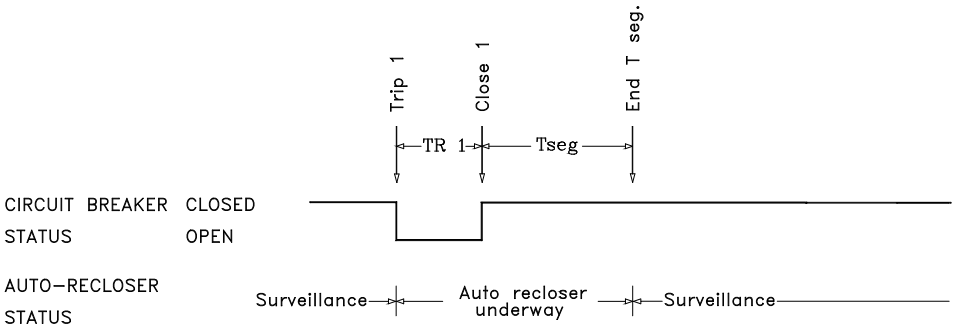
Closure conditions time (optional).

The time margin following a protection trip during which the closure conditions (Reference voltage presence) must be fulfilled in order for the cycle to continue. It is not used if no inputs are programmed as “reference voltage”.

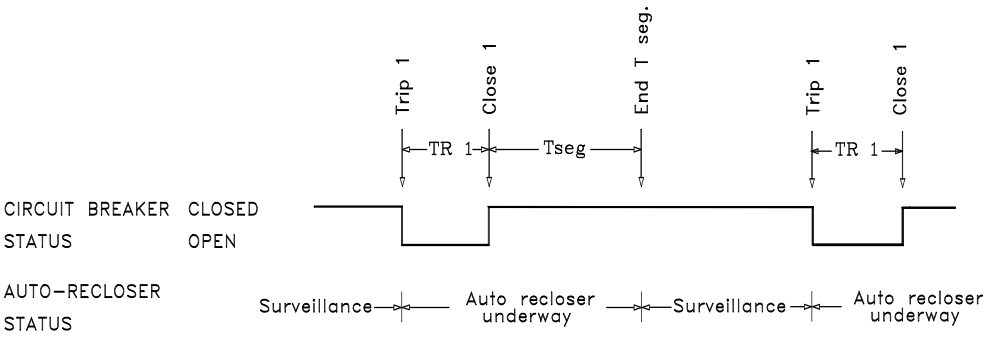
Operation

The figures below show the sequence of events for a reclosure which has been programmed for three reclosure attempts (TR1, TR2 and TR3, respectively), with a safety period of Tsec, for different situations:

a.- Successful first reclosure.

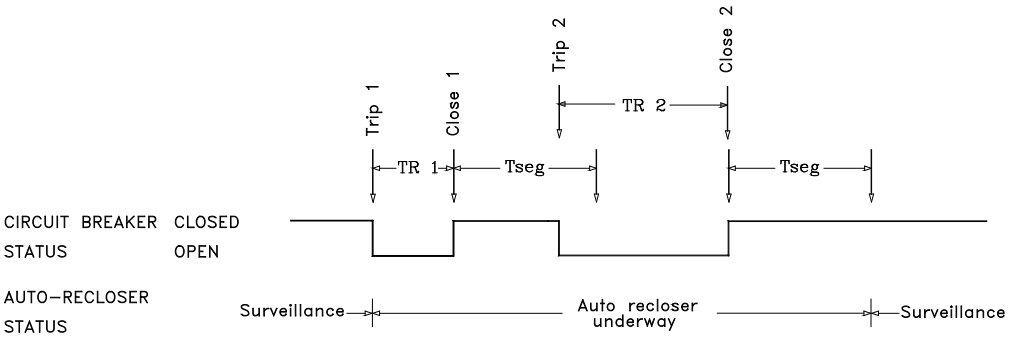


Once the Surveillance status has been reached, a new trip causes of a new cycle to begin and reclosure 1 is started once more, as shown below:

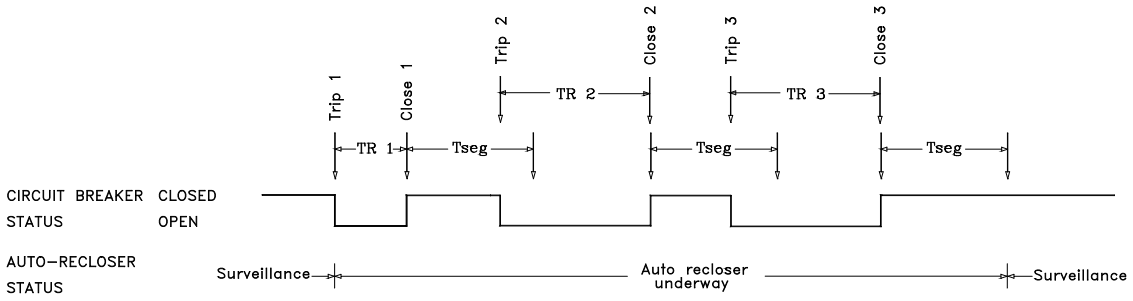


WARNING! A low current permanent fault may cause tripping following the elapse of the safety period. In such a situation and in 1order to avoid all the reclosures being considered first reclosures and the non-existence of a definitive trip, the safety period is automatically extended if a pick up is produced before the period expires and until such time as a drop-off or trip is produced.

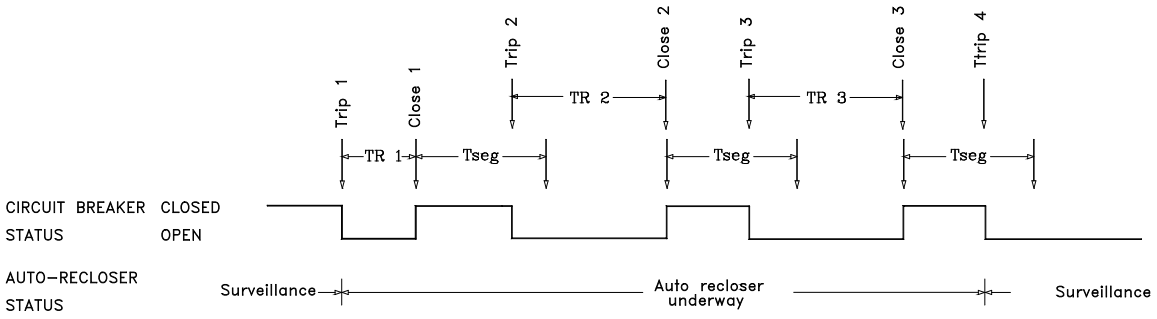
b.- Successful second reclosure.



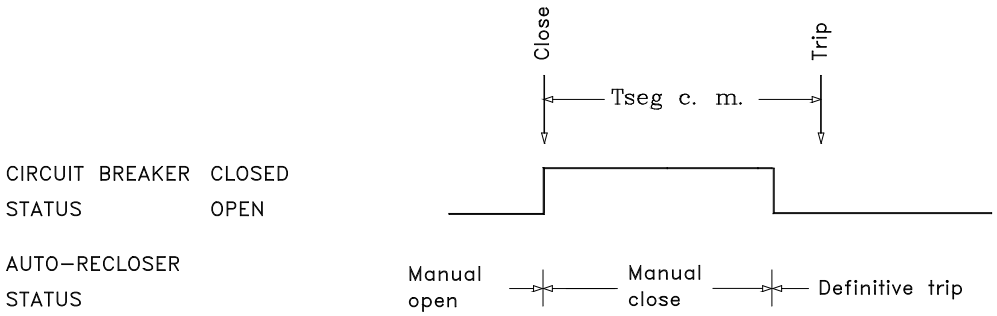
c.- Successful third reclosure.



d.- Changes to definitive trip after exhausting the number of programmed of reclosures.



e.- Changes to definitive trip due to a trip during the safety period following a manual closure.



Settings range (4 tables)

Setting	Minimum	Maximum	Step	Remarks
Recloser in service				YES/NO
Number of reclosures	0	4	1	
Waiting time for first reclosure for faults between phases (s)	0,05	600,0	0,01	
Waiting time for second reclosure for faults between phases (s)	1	600	1	
Waiting time for third reclosure for faults between phases (s)	1	600	1	
Waiting time for fourth reclosure for faults between phases (s)	1	600	1	
Waiting time for first reclosure for earth faults (s)	0,05	600,0	0,01	
Waiting time for second reclosure for earth faults (s)	1	600	1	
Waiting time for third reclosure for earth faults (s)	1	600	1	
Waiting time for fourth reclosure for earth faults (s)	1	600	1	
Safety period following automatic closure for faults between phases (s)	1	600	1	
Safety period following automatic closure for earth faults (s)	1	600	1	
Safety period following manual closure (s)	1	600	1	
Waiting time for reference voltage (s)	1	600	1	

Trip enabling (4 tables)

By selecting “YES" or "NO", the trip enabling is programmed for each of the possible tripping conditions

- phase timing (each level)
- neutral timing (each level)
- sensitive neutral timing (each level)
- phase instantaneous (each level)
- neutral instantaneous (each level)
- sensitive neutral instantaneous (each level)
- broken conductor and current unbalance
- external protection activation
- residual current instantaneous
- residual current timed

If it is enabled or not in each of the following circumstances

- in stand-by
- following manual closure
- following first reclosure
- following second reclosure
- following third reclosure
- following fourth reclosure

Trip disabling by means of this procedure is effective during the corresponding safety period and with the condition that the recloser is engaged.

If the enabling of "trip due to action of external protection" is set to "NO", the recloser will not consider the input in question during the safety period. If a circuit breaker opens as a result and without a trip command having been issued by the corresponding protection, the opening will be considered as a manual opening and, therefore, reclosure will not occur.

Closure enabling (4 tables)

By selecting "YES" or "NO", the permissions for each of the possible reclosures following each of the possible causes capable of provoking trips as detailed in the previous section are programmed, as well as for external protection trips.

In the event of various units issuing trip commands with different recloser enabling criteria during a fault, the reclosure is decided internally in accordance with the settings established for the first trip (in order, not in time) produced, according to the following order:

phase timing (each level)

neutral timing (each level)

sensitive neutral timing (each level)

phase instantaneous (each level)

neutral instantaneous (each level)

sensitive neutral instantaneous (each level)

broken conductor or unbalance

external protection activation

residual current instantaneous

residual current timed

If the recloser is not enabled, the following recloser is analysed and so on either until an enabled recloser is found or until a definitive trip is produced.

To prevent reclosure by a specific protection unit, the R1 to R4 reclosure lock settings must be set to "NO" as of the last required reclosure. For example, if no reclosure is required following a timed phase trip and the maximum number of programmed closures is 1, all closures (R1 to R4) following this type of trip must be set to "NO".

Other operating characteristics

Recloser out of service.

This status is reached by pressing the push-button R on the keyboard, or by means of a Control command. All relays associated to the recloser are de-excited.

Definitive trip

In addition to the above-mentioned causes, this status is also reached by means of a trip when the recloser is locked.

Recloser locked

This status is reached by the activation of an input or logic programmed as a recloser lock. No cycle is initiated in this status, whilst any cycle already initiated is abandoned, changing to the Definitive trip if the breaker is opened by a protection trip.

Bus bar voltage monitoring

Optionally, if a digital input is programmed as “Reference voltage” and applied to a busbar voltage relay, a function which prevents the automatic closure of the breaker when the busbar is de-energized is run. The use of this input is optional. If no input is programmed as Vref, the busbar voltage condition is not required for the recloser automatism to perform a closing operation.

Manual operation during the cycle.

If, during the operating cycle, a manual order (or command) is given to the circuit breaker, the recloser suspends the cycle switches to idle status.

Digital outputs associated to the recloser (and which can be programmed as output relays):

recloser in ongoing cycle. Active from the moment the breaker is opened by a trip until the monitoring or definitive trip status is reached.

recloser locked. Active if the recloser is out of service or if the external recloser lock input is activated.

closure (breaker closure order)

definitive trip. Active while the status is maintained.

override of instantaneous. Active during the safety period following an automatic closure. It can be used to lock other protections (external).

Logic inputs associated to the recloser, which can be assigned to physical inputs:

Breaker status. This input is **necessary** for the reclosure function.

Reference voltage. Not necessary. If programmed, the recloser function requires proof of the closure of this input in order to carry out the reclosure. If it is not programmed, this condition does not apply.

Recloser lock. As its name indicates, it locks the automatism. It is not necessary if the locking function is not required.

External protection. It can provoke the initiation of a reclosure cycle if the reclosure enablings are set to "YES" due to the "external protection" cause. Not necessary.

1.57 SEQUENCE COORDINATION

The aim of this function is to enable the recloser to advance along the reconnection sequence in the event of an interruption of a fault by another recloser located down current, even when the initial recloser does not trip its own breaker.

If the coordination function is enabled, the recloser will enter into a current cycle upon the detection of the start-up of protection (instead of a trip, which is more usual). As of this moment, it will meter (cyclewise) the current interruptions as trips and the current drop offs as reclosures.

Thus, in the case of two units in series (with the downstream unit programmed with shorter tripping times than the upstream unit) faced with a permanent fault located even further downstream, the downstream unit effectively carries out trip and reclosure operations, whilst the upstream unit continues in its own cycle status.

If, for example, 3 fast and 1 slow trips have been programmed for each, the only unit to act, with the 4 trips, is the downstream unit. If there is no coordination, the downstream units would trip 3 times, the upstream unit 3 times and the downstream unit once more (definitive), cutting the line between both units on 3 occasions without motive.

The only setting related to this function is Enable YES/NO. It can be found on the “Recloser (1)” screen. By keyboard/display, on the level following “Recloser”.

1.58 RECLOSURE FOLLOWING A MINIMUM FREQUENCY TRIP

General description

The unit, following a minimum frequency trip and in the event of the function having been enabled and not locked, will only attempt one reclosure.

When the trip occurs, the 79f-breaker closure lock signal is activated and the period programmed as the definite trip waiting time is observed. If the minimum frequency condition is set to “NO” or if the frequency is higher than the minimum programmed frequency during the programmed reclosure time, a closure order is sent to the breaker if the minimum voltage reclosure condition is set to “NO” or if the voltage is higher than the programmed minimum.

If the programmed definitive trip waiting time elapses without the reclosure conditions having been met, the definitive trip is adopted.

A safety period is observed following the closure of the breaker. If a new minimum frequency trip occurs during this period, it moves to definitive trip.

Setting the recloser out of service by command or by a digital input lock affects this operating mode.

Settings

Setting	Minimum	Maximum	Step	Remarks
Enabling				YES/NO
Min. freq. reclosure condition				YES/NO
Min. reclosure frequency	40	70	0,01	
Min. volt. reclosure condition				YES/NO
Min. reclosure voltage	12	200	1	
Closure time (s)	1	1.000	1	
Safety period (s)	1	300	1	
Definitive trip waiting time enabling				YES/NO
Definitive trip waiting time(s)	0	86400	1	

1.59 SYNCHROCHECK

Synchrocheck

General description

The “synchrocheck” function (function 25) is employed to condition the breaker closure to the compliance of the conditions established by setting. Two digital outputs may be programmed as “closure permission” and “syncrocheck failure” (which always have opposite statuses, except when the voltage lies between the “Presence” and “Absence” limits, the signals of which may both shown zero). They are used in the closure coil command circuit or as a signal for a closure automatism, when applicable.

This function can be disabled (by a setting or by a digital input). In such a case, there will always be closure permission.

The function compares the voltage signals of the same phase on both sides of the breaker (which we will call A and B). The unit directly compares the voltages received by its analogue inputs, i.e., the secondary values of the voltage measurement transformers. It is supposed that the transformation ratio of these is the same in the busbar and in the line. There is no correction factor in the event of these ratios not coinciding.

There are two types of closure conditions:

1. Undervoltage permission. Permission is given if there is no voltage on one or on both sides of the breaker, according to the following settings:

Permission if there is no voltage in A nor in B (YES or NO)

Permission if there is no voltage in A but there is voltage in B (YES or NO)

Permission if there is no voltage in B but there is voltage in A (YES or NO)

Voltage is understood not to be present on one side of the breaker when the voltage measured is lower than the value programmed as “minimum voltage” for the side in question.

In the event of voltage presence on both sides, the “synchronism permission” function is activated.

The analysis of the undervoltage conditions is only carried out if the synchrocheck function is enabled, i.e., it is not an undervoltage protection (type 27), but rather an auxiliary element to enable closure in certain conditions in which a comparison between the busbar and the line voltages would grant give permission. As has been mentioned, if the synchrocheck function is disabled the closure permission is issued.

2. Synchrocheck permission. Permission is given when following conditions are simultaneously fulfilled during a programmable time:

Difference between VA and VB lower than the programmed value

Difference in phase angles lower than the programmed value

Difference in frequencies lower than the programmed value

Each one of these three conditions can be enabled/disabled. If disabled, permission if granted.

Any relay programmed as “closure permission” is activated when the mentioned conditions are fulfilled. Thus, any closure can be locked if the relay is used as a lock for the manual command.

Please note that this permission refers only to the synchrocheck function, which is in turn responsible for controlling the “closure permission” relay. This must not be confused with “closure”, which is a relay controlled by closure commands (digital input or command).

The function does not take into account the breaker status, i.e., it can grant closure permission although it is closed.

Settings

Setting	Minimum	Maximum	Step	Remarks
Enabling of the function				YES/NO
Voltage presence on side A (V)	10	200	1	
Voltage presence on side B (V)	10	200	1	
Absence of voltage on side A (V)	10	200	1	
Absence of voltage on side B (V)	10	200	1	
Enabling of “without voltage in A or B”				YES/NO
Enabling of “without voltage in A, voltage in B”				YES/NO
Enabling of “without voltage in B, voltage in A”				YES/NO
Voltage diff. condition enabling .				YES/NO
Voltage difference (V)	2	90	1	
Frequencies diff. condition enabling .				YES/NO
Frequency difference (Hz)	0.05	2	0.01	
Angle diff. condition enabling .				YES/NO
Lead/lag difference (º)	5	50	1	
Conditions compliance time (s)	0	100	0,01	

Undervoltage protection

Settings

Setting	Minimum	Maximum	Step	Remarks
Undervoltage enabling				YES/NO
Trip voltage on side A (V)	10	200	0,1	
Trip voltage on side B (V)	10	200	0,1	
Additional timing (sec.)	0	600	0,1	

Operation

The protection is tripped when the voltage drops below the trip settings established for each side during the programmed period.

1.60 SECTIONALIZER AUTOMATISM

As of version “a”, a new functioning mode has been added to the sectionalizer automatism (mode 2 or simplified). These 2 modes of functioning MODO 1 and MODO 2 or simplified are selectable via settings.

This automatism can be enabled or disabled in both remote and local modes:

Local: by means of the “Automatic/manual” button. By pushing the button for 0.25 seconds, the status alternates between “automatic” and “manual”.

Remote. By means of a control command. The unit will accept the command only and solely if the digital input programmed as “Local/Telecommand” is activated (0 exclusively local mode, 1 local and telecommand mode).

MODE 1

This scheme allows up to 3 current passovers due to fault detection prior to the issuing of an opening command.

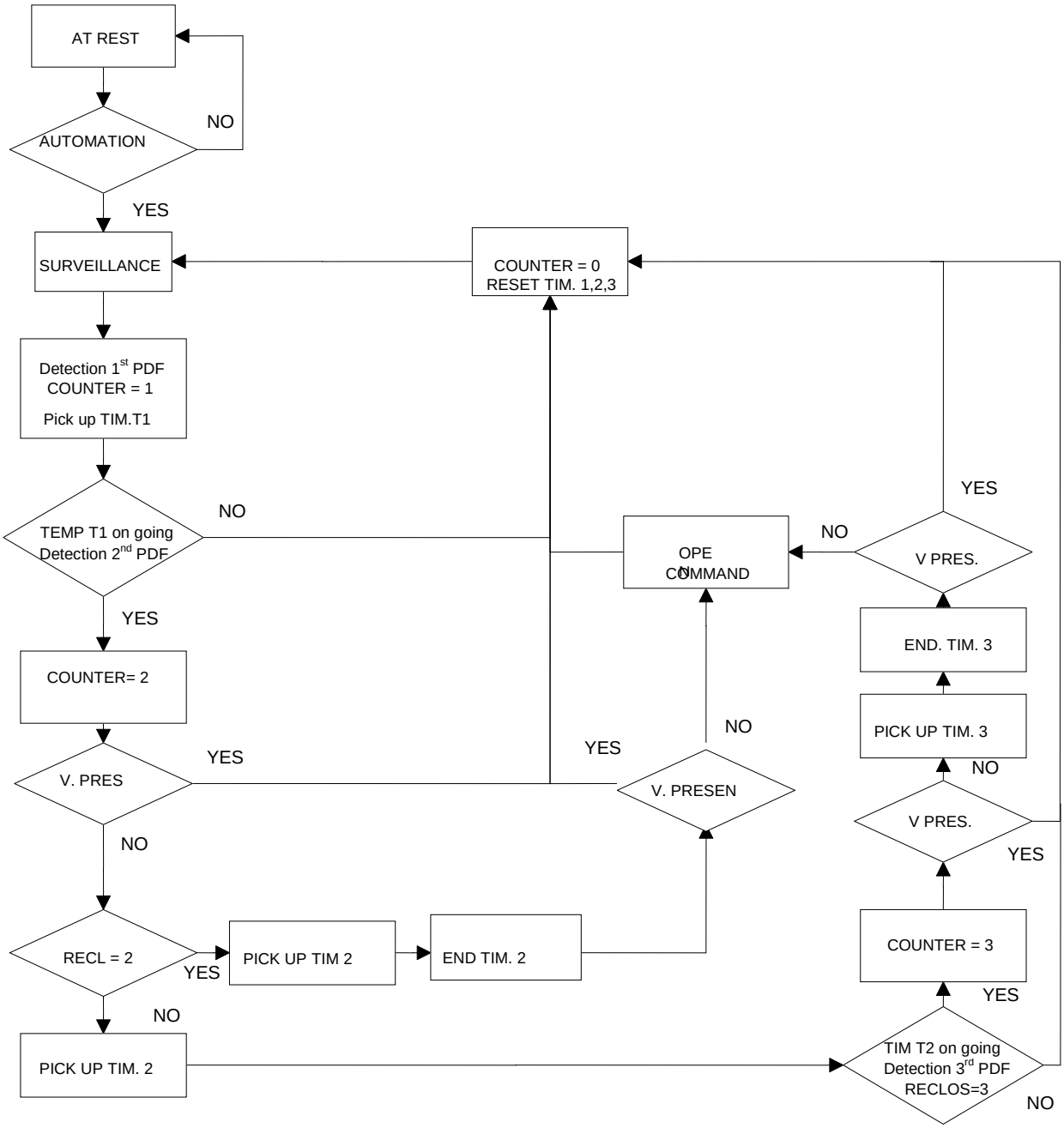
The following page contains a flow diagram of this automatism. The different elements which appear in the diagram are described below:

PDF: Current passover due to fault signal. This is the signal generated by the current passover due to fault detection function. It is a logical “OR” between the passover due to phase fault and the passover due to neutral fault.

PRES.V: Voltage presence. It corresponds to the signal, also present in the passover due to fault function.

RECL: Number of reclosures in the head line. Settable.

TIM. T1, T2, T3: Timings set in seconds



MODE 2 or simplified

In the simplified mode, each passover due to fault detection is accompanied by the start up of a time meter which, once having reached its limit, sets the current passover counter to zero and the automatism is reset.

If the breaker is closed with the automatism enabled (auto), the existence of new faults or opening commands is monitored.

In the event of detecting a current passover:

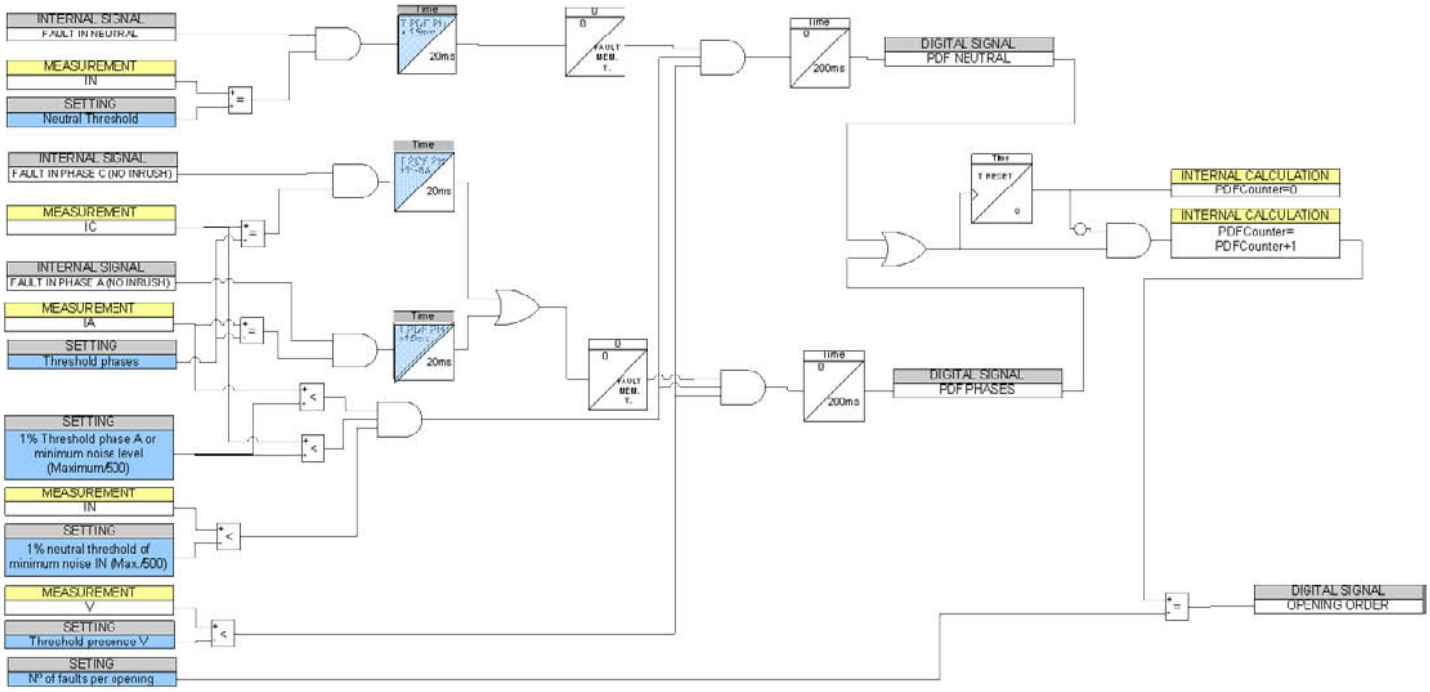
The fault meter is increased.

A Treset timer .picks up

As of this moment, the monitoring for new faults is active. In the event of new current passovers due to fault detection, the meter will increase until matching the number of faults defined for the opening, which is when the breaker opens. Nevertheless, in the event of a time superior to Treset elapsing after the last fault without a new fault occurring, the fault meter will be set to zero and await a new cycle.

The functioning scheme of the entire automatism, including DPF, is shown below.

This scheme allows up to 4 current passovers due to fault detection prior to the issuing of an opening command.



1. Current passover due to fault detection and sectionalizer diagram

Example of functioning (mode 2)

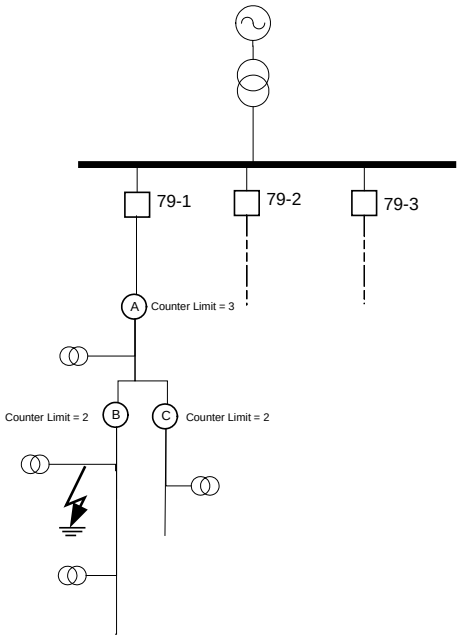
The following example shows the functioning sequence for a fault downstream from sectionalizer B in mode 2.

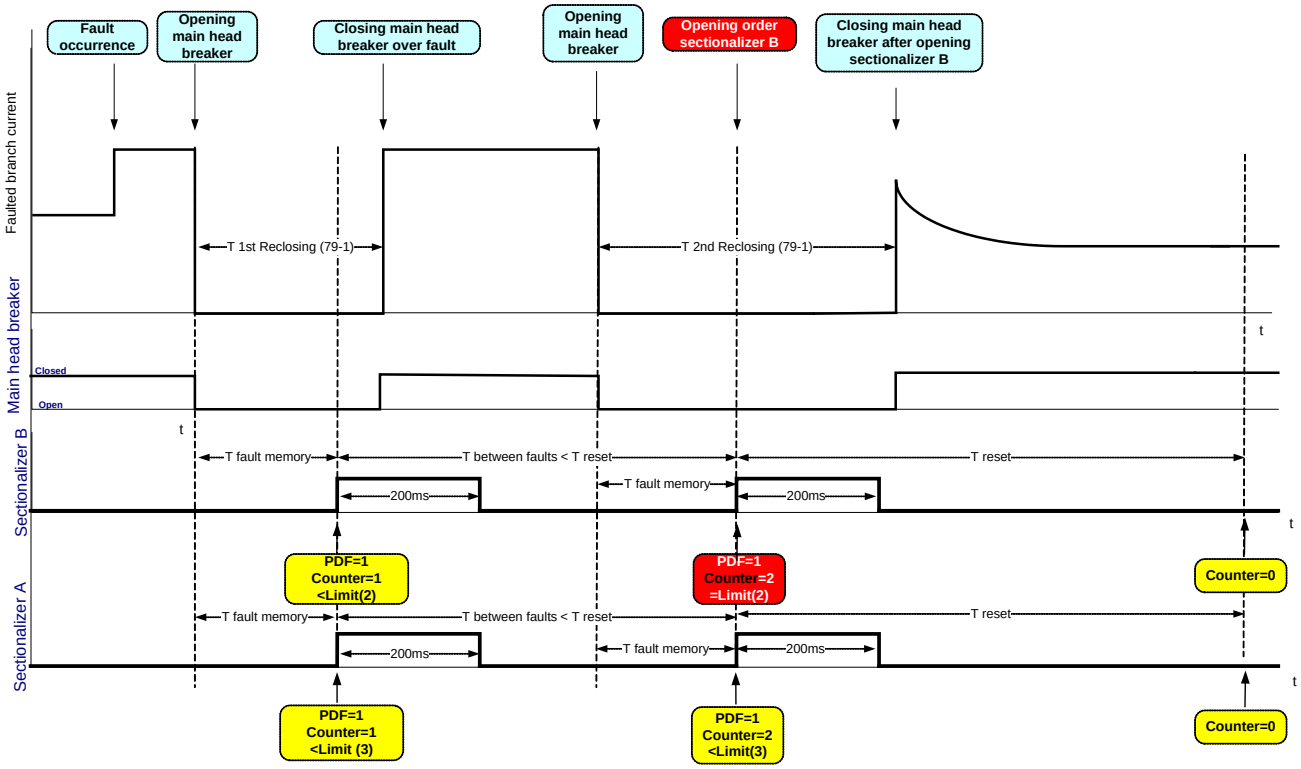
The normal operating sequence is:

1. Upon the appearance of the fault, the recloser 79-1 trips due to overcurrent and opens the head breaker. Sectionalizers A and B detect the overcurrent and the subsequent disappearance of the same. Following a voltage-free time (fault memory t), sectionalizers A and B count the first fault (DPF at 1). Any fault which is not downstream from the sectionalizer will not be seen as a fault (as in the case of sectionalizer C).

2. The recloser 79-1 closes the breaker. A persistent fault will be cleared within a set time. Following the opening of the breaker, the current disappears and, following a voltage-free period, A and B count a 2nd current passover. Simultaneously, B issues an opening order, having been programmed to act when the meter registers 2 current passovers.

3. The recloser 79-1 issues a second successful closure command following the 2nd reclosure time. The faulty stretch is cleared by the sectionalizer in B.





Settings

These settings can be found in the protection console in the “Cut-out organs protection” screen.

Setting	Minimum	Maximum	Step	Remarks
Number of faults before breaking	2	4	1	
Time period T1 (sec.)	1	99	1	Mode 1 only
Time period T2 (sec.)	1	99	1	Mode 1 only
Time period T3 (sec.)	1	99	1	Mode 1 only
Reset time TR (sec)	1	99	1	Mode 2 only
Sectionalizer automatism enabling				Mode 1 / Mode 2

If the number of faults prior to an opening is set at 4 in mode 1 of the sectionalizer automatism, the automatism acts as if it had been set at 3.

As opposed to mode 1, there is no waiting time prior to the issue of an opening command in mode 2.

1.61 SLACK SPRING AUTOMATION:

It is formed of:

"Slack spring" digital input

"Spring motor opening" LED

"spring tensing time" setting (0.1 to 99.9 sec)

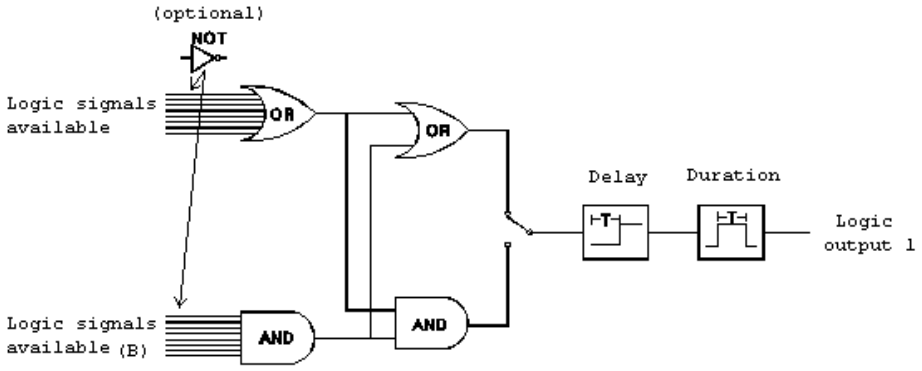
Operation: when the “slack spring” input is activated, an internal “closure lock due to slack springs” signal is generated and a timing period, defined by the "tensing time" setting, is initiated. If the input is disabled before the elapse of the programmed time, the lock is removed. If the timed period concludes without an opening, the “spring motor opening” LED is activated, a Procome “slack spring alarm” signal is issued and the lock is maintained. The alarm and the lock do not disappear until the input is deactivated.

OTHER SETTINGS

1.62 LOGICAL OUTPUT PROGRAMMING

The user can configure up to 10 logical outputs, called "logic 1" to "logic 10", which can be assigned to relays as well as to LEDs, locking inputs, signals to be registered on the oscillograph, etc.

The logical outputs can only be programmed through the Protections console, not via keyboard/display, in accordance with the basic signals available, which are detailed in the Appendix "Available signals" (as many of the signals correspond to optional functions, not every model is equipped with all the signals). The programming procedure is described in another document: the Protections Console Manual.



The logic signals can be generated according to the following scheme:

As can be observed in the definition of a logic output, the following elements intervene:

- up to 16 signals from among those available (or those negated), forming an “OR” function
- up to 16 signals from among those available (or those negated), forming an “AND” function
- an “OR” or “AND” function (programmable) of the results of the two previous functions
- a programmable timing ("delay") to activate the output
- a programmable time for the duration of the output activation

The delay time is the period as of the moment in which logic 1 is registered at the logic ports’ output until the corresponding logic output is activated. If during the "1" disappears during this time, the output is not be activated. It can be programmed between 0 and 99.9 s, with steps of 0.1 s.

The pulse time (duration) is the time during which the logic signal remains active. The programming allows for two options:

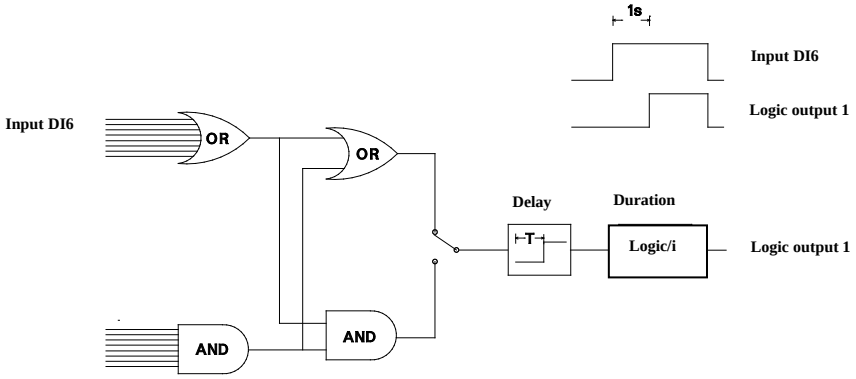
"By logic": following the delay, the output is active as long as there is 1 is registered at the programmed logic output.

"By time": the time during which the output is active is programmed. Upon the expiry of this period, the output is deactivated, independently of the status of the programmed logic output. Only a new step from 0 to 1 will activate the output once more following the delay.

The time range is 0.1 s to 600 s, with steps of 0.1 s.

A logic output "i" can be used as an available signal for the programming input of another logic signal "j", or of “i” itself.

A very simple application example: digital output DO7 is to follow digital input DI6 with a delay of 1 s.



Application 1. Timed

T delay = 1s.

Duration = "by logic"

Programming of output DO7: Logic 1

1.63 HISTORICAL RECORD

The settings corresponding to the historical report are detailed in the “Historical report” section of the “Data Acquisition Functions” chapter.

DATA ACQUISITION FUNCTIONS

1.64 EVENTS REPORTS

The list of events which can be generated by the protection (if it has the corresponding functions, which are optional in many cases) is indicated as follows. Each event is accompanied by its date, time and phase and neutral measurements. The protection saves a 400-event queue in non-volatile memory, which is retrievable from the PC.

Certain events may be masked via the console in the "Event Masking" screen.

Non maskable events

- Activation table 1
- Activation table 2
- Activation table 3
- Activation table 4
- Settings (change) table 0
- Change settings table 1
- Change settings table 2
- Change settings table 3
- Change settings table 4
- Recloser out of service
- Recloser in service
- Relay out of service
- Relay in service

Maskable events

- Communications
  - Local mode (activation from keyboard/display)
  - Local mode (activation through front port)
  - Remote mode (activation through rear port)
- Current protection
  - Phase A timing pick up
  - Phase B timing pick up
  - Phase C timing pick up
  - Phase A instantaneous pickup
  - Phase B instantaneous pickup
  - Phase C instantaneous pickup
  - Activation of phase A timing output (trip)
  - Activation of phase B timing output
  - Activation of phase C timing output
  - Activation of phase instantaneous output
  - Activation of phase B instantaneous output
  - Activation of phase C instantaneous output
  - Neutral timing pick up
  - Neutral instantaneous pickup
  - Activation of neutral timing output
  - Activation of neutral instantaneous output

- Current unbalance timing pickup
- Current unbalance instantaneous pickup
- Activation of current unbalance timing output
- Activation current unbalance instantaneous output
- Broken conductor unit pickup
- Broken conductor output activation
- Breaker failure
- Trip circuit failure
- Closure circuit failure
- Breaker monitoring accumulator maximum (set limit) exceeded
- Overflow (numeric limit) of the circuit breaker supervision accumulator

Voltage protection

- Phase A surge timing pick up
- Phase B surge timing pick up
- Phase C surge timing pick up
- Neutral surge timing pick up
- Phase A instantaneous pickup
- Phase B surge instantaneous pickup
- Phase C surge instantaneous pickup
- Neutral surge instantaneous pick up
- Activation of phase A surge timing output (trip)
- Activation of phase B surge timing output
- Activation of phase C surge timing output
- Activation of neutral surge timing output
- Activation of phase A surge instantaneous output
- Activation of phase B surge instantaneous output
- Activation of phase C surge instantaneous output
- Activation of neutral surge instantaneous output
- Phase A undervoltage timing pick up
- Phase B undervoltage timing pick up
- Phase C undervoltage timing pick up
- Neutral undervoltage timing pick up
- Phase A undervoltage instantaneous pickup
- Phase B surge instantaneous pickup
- Phase C undervoltage instantaneous pickup
- Neutral undervoltage instantaneous pickup
- Activation of phase A undervoltage timing output (trip)
- Activation of phase B undervoltage timing output
- Activation of phase C undervoltage timing output
- Activation of neutral undervoltage timing output
- Activation of phase A undervoltage instantaneous output
- Activation of phase B undervoltage instantaneous output
- Activation of phase C undervoltage instantaneous output
- Activation of neutral undervoltage instantaneous output

Synchrocheck

- Undervoltage pick up side A and B
- Undervoltage pick up side A
- Undervoltage pick up side B
- Undervoltage trip side A and B
- Synchrocheck fault

Inputs

- Activation of digital input xx (1 to 8)
- Deactivation of digital input xx (1 to 8)

Recloser

- External locking of the recloser
- External unlocking of the recloser
- No reference voltage
- Reclosure order
- Definitive trip
- Recloser in idle
- Recloser in ongoing cycle

Command

- Excessive number of trips
- Breaker closure
- Breaker opening
- Breaker closure command (control message or input)
- Breaker opening command (control message or input)
- Closure command failure
- Breaking command failure

Self-check

- Critical Hardware Error
  - Converter reference voltage error
  - Converter error
  - FLASH memory recording error
  - Relay activation error
  - SPI communication error (between micro and DSP converter)
- Non critical Hardware error
  - “ clock synchronization error
- HW error corrected

1.65 FAULT REPORTS

The protection stores a queue of the last 20 faults in non volatile memory, which is retrievable from the PC with the following information

- Available units
- Units tripped during the fault
- Units picked up during the fault
- Fault start date and time (first unit picked up)
- Trip date and time (first tripped unit)
- Fault end date and time (when the trip signal disappears)

Current cleared by circuit breaker (maximum of the phase currents detected between the moment of the trip order and the breaker opening)

Setting table active during the fault.

Fault and trip type: 3-letter code composed of combinations of the characters A, B, C, N and D, depending on whether the trip was effected for each phase, neutral or unbalance-broken conductor. Example: ACN is a two phase (A and C) to earth fault.

Pre-fault Phase A current (module and angle).

Pre-fault Phase B current

Pre-fault Phase C current

Pre-fault neutral current

Phase A prefault voltage (module and angle).

Phase B pre-fault voltage

Phase C prefault voltage

Neutral pre-fault voltage

The 4 pre-fault currents and voltages are simultaneous and correspond to the values existing 3 cycles prior to the pick-up.

Phase A fault current (module and angle)

Phase B fault current

Phase C fault current

Neutral fault current

Phase A fault voltage(module and angle)

Phase B fault voltage

Phase C fault voltage

Neutral fault voltage

The 4 fault currents are simultaneous and correspond to the values existing upon the issue of the trip order.

Furthermore, they are kept in non-volatile memory and they are retrievable through the keyboard /display. The following data corresponds to the last 5 faults:

Tripped phases

Maximum currents and voltages of each phase and neutral during the fault

Fault start and finish date and time

1.66 MEASUREMENTS

Measurements in the secondary

These measurements refer to the fundamental component and are used by the protection functions:

By keyboard/display

Phase, neutral, sensitive neutral, residual currents (in Amperes)

Current maximeter (in Amperes)

Inverse sequence component I2 / I1 in %

Phase, neutral, phase to phase voltages (in Volts)

Frequency (Hz)

Note on the maximeter: The maximeter shows the maximum average value of the average current of the three phase during a specific time interval. The time interval is the period programmed as the “time window for samples” in the “Historical report” setting. The functioning is as follows: the average current of the three phases is calculated each second and accumulated; upon completion of the interval, the accumulated

value is divided by the corresponding number of seconds and, thus, the average value of this interval is obtained. If this value is higher than the maximeter value, the new value is used, together with date and time when it was obtained.

Via PC (Protections Console)

The first "STATUS" screen shows the following:

Phase, neutral, sensitive neutral and residual currents (module in Amperes and angle in degrees)

Current maximeter (in Amperes)

Phase and neutral voltages (module in Volts and angle in degrees)

All the angles refer to Phase A.

Measurements in the primary

By keyboard/display

Phase, neutral, sensitive neutral, residual currents (in Amperes)

Phase, neutral, phase to phase voltages (in kilovolts)

Via PC (Protections Console)

The “MEASUREMENTS” screens show:

Phase, neutral, sensitive neutral and residual currents (module in Amperes and angle in degrees)

Phase, neutral, phase to phase voltages (module in kilovolts and angle in degrees)

Frequency (Hz)

Current maximeter (in Amperes)

Maximeter date and time

1.67 HISTORICAL MEASUREMENT REPORT

General description

In versions released before firmware version “a”, the protection saves a 200 record queue in a non-volatile memory. In versions “a” and subsequent versions, the number of records saved by the protection in the non-volatile memory depends on the “Nº of records to be registered” setting. These settings can be found in the protections console in the “Historical reports” screen. See section “Dynamic management of historical reports and disturbance recorder”.

Changes to the “Nº of historical reports to be recorded” setting will delete both the historical report queue and the disturbance recorder queue.

The historical report information may be accessed from a PC (Protections Console).

Each record includes the maximum and minimum average currents, the maximum and minimum average phase to earth voltages and the maximum and minimum real, reactive and apparent power (calculated within a programmable time window) detected during a programmable recording period. The currents are secondary Amperes, and the voltages are secondary Volts.

The functioning is as follows: the current values (three phase average) are increased each second and added to their respective accumulators. Upon the conclusion of the time window, the accumulated value is divided into the number of seconds corresponding to the window in order to obtain the average value. Upon completion of the programmed registration interval, the maximum and minimum values of the measurements obtained during the interval are registered.

The registration interval is automatically synchronised with the clock. Thus, if a 15-minute period is programmed, 4 reports are generated per hour (at 0, 15, 30 and 45 minutes).

Calendar mask functioning:

If the "Calendar Mask" setting is set to "NO", the report is generated each day of the week. If it is set to "YES", the daily programming is observed. All days set to "YES" are reported, whilst all days set to "NO" are omitted.

Settings range (4 tables)

Setting	Min	Max	Step	Remarks
Time window for average(min.)	1	15	1	
Historical report interval (min.)	1	1.440	1	
Calendar mask day week				Monday to Sunday YES/NO
Calendar mask				YES/NO
Report start time	0	24	1	
Report end time	0	24	1	

1.68 STATISTICAL DATA

The same information can be obtained by keyboard/display or via PC ("STATISTICAL DATA" screen):

kI2 sum (kA broken per breaker pole, squared)

Automatic reclosure meters

First reclosure

Second "

Third "

Fourth "

Total

Breaker openings meter (by trips or by manual breaks)

All these meters can be set to 0, with the kI2 sum set to the initial value programmed as a setting.

1.69 PROTECTION STATUS

By keyboard/display

The following can be consulted:

Date and time of the relay.

Status of each of the digital inputs: open (O) or closed (C).

Via PC (Protections Console)

In addition to the above-mentioned measurements, the following can also be consulted via the "STATUS" screens:

on screen 1

Date and time of the relay

Active table

on screen 2

Protection units picked up at the present moment

Protection units tripped at the present moment

on screen 3

Units tripped during the last trip

Command orders

Circuit breaker monitoring status

Closure and trip circuit monitoring status

1.70 OSCILLOGRAPH DATA RECORDER

In versions prior to the firmware version "a", the protection saves up to 600 cycles in non-volatile memory. The cycles may be distributed in records containing 20 30-cycle disturbances, 10 60-cycle disturbances or 5 120-cycle disturbances (the number of cycles prior to pick-up is programmable in each case). In versions “a” and subsequent versions, the number of records saved by the protection in the non-volatile memory depends on the “Nº of records to be registered” setting. These settings can be found in the protections console in the “Historical reports” screen. See section “Dynamic management of historical reports and disturbance recorder”.

The information that can be saved by the oscillograph function depends on the number of cycles to be saved in relation to each disturbance and the number of historical reports. See section “Dynamic management of historical reports and disturbance recorder”.

Changes to the “Nº of historical reports to be recorded” setting will delete both the historical report queue and the disturbance recorder queue.

The number of cycles related to each disturbance and the number of cycles prior to the pick up are selectable via settings. Increasing the number of cycles to be saved in relation to each disturbance reduces the number of disturbances that may be saved. These settings can be found in the protection console in the “Disturbance recorder configuration” screen.

Up to 5 analogical channels and up to 32 digital channels, which can be chosen from a list selected from the available signals, are registered for each disturbance.

Each disturbance recorder can be launched by a rising slope from any of the digital signals considered by the protection model.

The analogical channels are sent to the console and multiplied by the transformation ratio in order to appear in primary values. The number of samples per analogical channel cycle is 32.

1.71 DYNAMIC MANAGEMENT OF HISTORICAL REPORTS AND DISTURBANCE RECORDERS

The unit manages the memory dedicated to the historical reports and disturbance recorder dynamically. The two data queues share the same memory zone. Thus, increases in the number of historical reports saves imply a reduction in the number of disturbance reports saved.

The number of historical reports recorded by the unit may be varied via a setting. The setting can be found in the protections console in the “Historical reports” screen.

Setting	Values
No. of historical reports to be recorded	200, 500, 1000, 2000, 3000, 4000

Changes to the “Nº of historical reports to be recorded” setting will delete both the historical report queue and the disturbance recorder queue.

The following table shows the number of disturbance reports saved for different numbers of historical reports and different disturbance durations in cycles.

	Queued historical reports					
Disturbance cycles	**200**	**500**	**1000**	**2000**	**3000**	**4000**
10	60	57	54	46	39	31
20	40	38	36	31	26	21
30	30	28	27	23	19	15
40	24	23	21	18	15	12
50	20	19	18	15	13	10
60	17	16	15	13	11	9
70	15	14	13	11	9	7
80	13	12	12	10	8	7
90	12	11	10	9	7	6
100	10	10	9	8	7	5
150	7	7	6	5	4	3
200	5	5	5	4	3	3
250	4	4	4	3	3	2
300	3	3	3	3	2	2
350	3	3	3	2	2	1
400	2	2	2	2	1	1
450	2	2	2	2	1	1
500	2	2	2	1	1	1
550	2	2	1	1	1	1
600	1	1	1	1	1	1

Note: *: In the RS family, the maximum number of queued historical measurement reports to be recorded is 2000.

OTHER FUNCTIONS

1.72 TIME SETTING AND SYNCHROCHECK

Time setting

The time can be set via the keyboard/display (within "Change Settings") or via the Protection Console (“STATUS" screen 1).

Synchrocheck

There is an input for demodulated IRIG-B synchrochecking (see section “IRIG-B input” in “Technical characteristics”). This system allows the synchronization of the times assigned to events between connected devices to be effected with a 1 ms margin.

The IRIG-B time code is a frame that is generated once a second. The code used is B 003, in which the frame is constituted by a train of variable-width TTL-level pulses. The time indicated corresponds to the PPS (Pulse per second) coincident with the Frame Reference Mark at the start of the frame.

In integrated protection and control systems (SIPC), the unit is synchronized periodically (every minute) by the UCS.

In this case, any change made to the time via the keyboard or the Protection console will be immediately eliminated by the UCS.

1.73 CONTROL MESSAGES

The protection responds to the following control messages

- Measurement, change and meter requests
- Digital status requests
- Clock synchronization
- Meter freezing
- Statistical data initialization commands
- Relay and specified digital signal orders
- Statistical data requests

The Procome event queue handles 400 events.

The following measurements are transmitted:

No. Bytes	Format	Specification	Data
2	Word	Procome Format	Current Maximeter
2	Word	Procome Format	VSYNC module
2	Word	Procome Format	VA module
2	Word	Procome Format	VB module
2	Word	Procome Format	VC module
2	Word	Procome Format	VAVERAGE module
2	Word	Procome Format	VAB module (Phase to phase voltage)
2	Word	Procome Format	VBC module (Phase to phase voltage)
2	Word	Procome Format	VCA module (Phase to phase voltage)
2	Word	Procome Format	VCAVERAGE module (Phase to phase voltage)
2	Word	Procome Format	IA module
2	Word	Procome Format	IB module
2	Word	Procome Format	IC module

No. Bytes	Format	Specification	Data
2	Word	Procome Format	IAVERAGE module
2	Word	Procome Format	IN module
2	Word	Procome Format	P (Real power)
2	Word	Procome Format	Q (Reactive power)
2	Word	Procome Format	S (Apparent power)
2	Word	Procome Format	Frequency
2	Word	Procome Format	Frequency synchrocheck
2	Word	Procome Format	INS Module
2	Word	Procome Format	VN Module (neutral)
2	Word	Procome Format	INIsolated module
2	Word	Procome Format	Unit temperature
2	Word	Procome Format	Iresidual module

The following table shows the measurements and the order (numbered from 1 onwards) for each of the families up to firmware version D:

Measurements	IT	IS	IM	RT	TH	TT	SV	PO	IV	MO	SC
Maximeter I	1	1	1	1					1	1	1
VSYNC											
VA						1	1	1	2		2
VB						2	2				
VC						3	3				
VAVERAGE						4	4				
VAB						5	5				
VBC						6	6				
VAC						7	7				
VCAVERAGE						8	8				
IA	2	2	2					2	3	2	3
IB	3	3							4	3	
IC	4	4							5	4	4
I AVERAGE	5	5							6	5	5
IN	6			2						6	
P								3			
Q								4			
S								5			
Frequency						9	9				
Freq.sync.											
INS		6									
VN					1	10	10				
INIsolated											
I residual	7	7							7	7	

From firmware subsequent to version E, the measurements programmed from among those available for each family are transmitted. The order in which they are sent can also be programmed. The programming is carried out through the SIPCON/P protection console.

The digital signals indicated as “Available signals” in the corresponding Appendix are treated (changes and status). The Procome Protocol facilitates the programming of the signals to be sent, together with the signal number.

The statistical data initialisation commands allow the closure meters, energy meters, the maximeter and the break meter to be set to 0, as well as allowing the initial value programmed as the kI2 sum setting to be established. The Procome Protocol command orders can be programmed (by Console) from among the following options:

Action	ISC	Default
Open breaker	programmable	22
Close breaker	programmable	24
Activate any relay from 1 to 11	programmable	1 to 11
Set recloser as out of service	programmable	28
Set recloser as in service	programmable	26
Table 1 activation	programmable	60
Table 2 activation	programmable	61
Table 3 activation	programmable	62
Table 4 activation	programmable	63
Set in LOCAL	programmable	not programmed
Set in TELECOMMAND	programmable	not programmed
Permanent activation output 1	programmable	not programmed
Permanent activation output 2	programmable	not programmed
Permanent activation output 3	programmable	not programmed
Permanent activation output 4	programmable	not programmed
Permanent activation output 5	programmable	not programmed
Permanent activation output 6	programmable	not programmed
Permanent activation output 7	programmable	not programmed
Permanent activation output 8	programmable	not programmed
Permanent activation output 9	programmable	not programmed
Permanent activation output 10	programmable	not programmed
Permanent activation output 11	programmable	not programmed
Deactivate output 1	programmable	not programmed
Deactivate output 2	programmable	not programmed
Deactivate output 3	programmable	not programmed
Deactivate output 4	programmable	not programmed
Deactivate output 5	programmable	not programmed
Deactivate output 6	programmable	not programmed
Deactivate output 7	programmable	not programmed
Deactivate output 8	programmable	not programmed
Deactivate output 9	programmable	not programmed
Deactivate output 10	programmable	not programmed
Deactivate output 11	programmable	not programmed

1.74 COMMAND KEYS

The SC, RC, RS and CT families are equipped with additional keys, indicated as “I”, “O”, “” (permission), “A/M” (Automatic/Manual) and, in the case of the RC family, “R” (protections in service/out of service) and “L/R” (Local/Remote). In order for these keys to become operational, the “ENAB.PUSHBUT.” setting must be enabled. This setting is accessible through the keyboard/display and the protections console. It is accessible via the keypad/display in "CHANGE SETTINGS" => "PROG TABLE 0” => “PROG. SPECIALS” => “ENAB.PUSHBUT.”. This setting is accessed via the protections console in “General SETTINGS”, "General Configuration" screen.

By simultaneously pressing the “I” and “·” buttons for 0.25 sec, the breaker’s “closure” relay is activated. By simultaneously pressing the “O” and “·” buttons, the breaker’s “opening” relay is activated. The relays remain active in accordance with the programming indicated in the “Sealing logic” section.

The functionality of the “A/M” key is explained in the “Sectionalizer automatism” section.

1.75 LOCAL/REMOTE COMMAND

The unit can be in local or remote (Tele-control) status.

The transition from the one status to the other can be effected by a digital input programmed for this purpose. The functioning is alternative, i.e., the status changes each time the input is activated (rising slope). In the SC, RC, RS and CT units, the change from one status to another one can be carried out by pushing the “L/R” (Local/Remote) key successively.

The control commands described in the previous section are only operative in Remote status.

The breaking and closure commands via digital input (when programmed) are operative both in the Local and in Remote status (to facilitate the command via contacts activated by a remote terminal).

The unit always picks up in the “Remote” status.

OPERATING MODE

1.76 VIA KEYBOARD/DISPLAY

Introduction

The keyboard/display unit facilitates the local entering of settings and commands into the unit via push-buttons, as well as enabling the display of settings, measurements and faults.

Keyboard/display unit elements

Normal push-buttons

They are 4 normal push-buttons, signalled as INTRO and ESC.

Push-button "↓"

This is the only push-button which accessible when the protection cover is in place.

By successive pushing the button, the following information appears:

- Digital input status
- Phase A current (primary A)
- Phase B current
- Phase C current
- Phase A voltage
- Phase B voltage
- Phase C voltage
- VAB voltage (primary kV)
- VBC voltage
- VCA voltage
- Real power (MW)
- Reactive power (MVAR)
- Power factor
- Information on the last fault
    - Phases involved
    - Fault current in phase A
    - Fault current in phase B
    - Fault current in phase C
    - Fault current in neutral
    - Fault start date and time
    - End date and time
    - Fault recognition (press 2 sec. and release). Turn off the trip LEDs

Display

Alphanumerical, liquid crystal and with 2 8-column rows.

LEDs

They are 7 LEDs, which can be programmed to show certain of the statuses indicated in the "LEDs programming" section.

Operating mode

General description

In idle, the display shows “PL70 XX”, in which “XX” corresponds to the unit’s family (for example: IT, TT, etc.). The second line shows the following 3 digits of the commercial code and the corresponding software version. The screen on which the stand-by status is to be viewed can be selected by simultaneously pressing “↓“ and “↑“ in the new screen.

By pressing the “ESCAPE” key at any moment during the process which is described below, the unit is taken to the element of the menu corresponding to the immediately prior level.

The menus can be scrolled downwards or upwards with the keys “↓” and “↑”, and they are circular, i.e., following the final position they return to the beginning.

Generally, when scrolling through a menu, the first line of the display indicates the active function, which can be entered by pressing INTRO, in turn facilitating access to the next menu level (when applicable) specific to the function in question.

The menu tree for the display or adjustment of settings within each group is hierarchical. If the INTRO key is pressed when the display is idle, the first element of the following menu is shown:

DISPLAY TIME

DISPLAY ACTIVE TABLE

INPUTS

OUTPUTS

MEASUREMENTS

STATISTICAL DATA

LAST FAULTS

DISPLAY SETTINGS

CHANGE SETTINGS

The complete hierarchy of menus and submenus is shown in the Appendix I.

Using the keyboard/display

Display settings and magnitudes

Using the keys "↑" and "↓", the user can scroll up or down through the menu or submenu (as indicated above), as the menus are circular.

By pressing “INTRO”, the next level of the menu is accessed. If there is no submenu, the status of the display does not change when “INTRO” is pressed.

Pressing “ESC” takes the user to the menu’s immediately superior element, i.e., the element via which we have arrived at the current status.

In the final menus, which have no submenus (settings), the first line shows the name of the setting of the group selected via the keyboard, whilst the second the line shows the current value.

Change settings

Up to the last level of the menus, the functions are the same as those for displaying settings and magnitudes (the same key functions).

To access to this function, key in "↑↑↓↓". This grants access to all the settings and initializations, with the exception of those contained in the "Special protections" sections. IN order to access these settings, key in "↑↓↵↵".

In the last level of the menus, which display the names of the settings to be changed, the keyboard functions are different to those explained above.

The functioning of the keyboard when entering each group in order to change the settings (final menu) is as follows:

1) Numerical settings. The first line of the display shows the name of the selected setting. Line 2 shows the current setting value.

The setting value is changed figure by figure. The user must use the "↑" key to select the figure to be changed. Each pulse moves us one figure to the left, in a circular manner. The selected figure will flash on the screen. In order to change it, press "↓" until the desired value is reached. Once all the figures have been set to their corresponding values, press "INTRO" in order to move to the following setting. If an invalid value is entered, an “INVALID” warning message will appear in line 2. In such a case, press "↑" and carry out the setting again. By pressing “ESC” in the final menu, the screen shows the previous menu element. The changes that have been made are not saved at this point.

The changes are saved when, upon reaching the group’s final setting and pressing “INTRO”, a “VALIDATE?” message appears in line 1. Line 2 will display the message “YES”, to which we respond by pressing “INTRO” to validate the changes. If we do not want to validate the changes, select “NO” using “↓” and then press “INTRO”. Independently of whether the changes are validated, pressing “INTRO” returns the screen to the next element of the superior menu (see menus chart). By pressing “ESC”, we return to the menu element from which we reached the current status.

2) Non numerical settings. There are settings, such as the enabling settings, which must be set either at YES or at NO. There are also time delayed curves with specific names, input and output configurations, etc., which are easier to select by their name rather than by entering a numerical value.

In these cases, the setting name appears in line 1, whilst a text indicating the present value appears in line 2. By pressing "↓" or "↑" in the second line, the values that may be chosen for the setting in question are displayed.

By pressing “INTRO”, either the following setting within the group or, if the setting is the last, the validation message is shown.

In the case of input, output, LED configuration, pressing “INTRO” takes us from the configuration of input/output/led “i” to the configuration of input/output/led “i+1”.

As with the numerical settings, pressing “ESC” takes us to the menu element from which we reached the current status.

When configuring inputs, outputs and LEDs, pressing "INTRO" takes us from the configuration of input/output/LED "i" to the configuration of input/output/LED “i+1”. As with the numerical settings, pressing “ESC” takes us to the menu element from which we reached the current status.

Initializations and special settings.

The first “Change settings" submenu offers the following option: "VARIOUS INITIAL.”, which requires a specific explanation.

By pressing "INTRO" in "VARIOUS INITIAL", the following is displayed:

"CLOS.METER=0?". By pressing “INTRO”, the total and partial reclosure meters and the break meters are set to 0. If the meters are not to be set at 0, press "↓" or "ESC".

"MAXIMETER=0?". By pressing “INTRO”, the maximeter is set to 0.

"SUM KI2=INIT?". By pressing “INTRO”, the accumulator adopts the setting value corresponding to the table indicated by the active table.

The “Special changes” submenu" of “Change settings" offers the following option:

“DELETE QUEUES?". By pressing "INTRO", all event, fault, historical report and oscillograph data record queues are reset.

Change active table.

In the first level of "CHANGE SETTINGS", pressing "INTRO" when in "ACTIVATE TABLE" displays "TABLE 1". “↑” and “↓” are used to change to "TABLE 2" and “TABLE 3”. When the table in question is reached, press "INTRO" to activate.

Display view of last 5 faults.

When accessing the LAST FAULTS menu, 5 submenus with the following texts are available:

FALTA Nº n

Fault 1 is the most recent fault, whilst fault 5 is the oldest.

The fault data can be viewed by accessing the corresponding submenu using INTRO.

Fault 1 can be recognised (switch off LEDs, etc.) by accessing the fault 1 submenu. This procedure is not applicable to the other faults.

Press “ESC” to return to the previous level

Display view of last fault.

When a trip is produced, the display shows the beginning of a fault report. The complete information is accessed by pressing “↓”.

If the fault is recognised or “ESC” is pressed, the first screen containing a description of the relay is shown.

1.77 VIA PC

The PL70 protection relays can be monitored by PC. This makes it possible to access the display the system measurements and settings and their programming.

The PC “Protection Console” programme developed by Ingeteam Technology S.A. is called SIPCON/P.

RECEPTION, STORAGE, INSTALLATION AND TESTS

1.78 RECEPTION AND STORAGE

The protections are supplied in special transport packaging.

Upon reception, the units should be checked for any signs of external damage caused during transport. If any such damage is detected, the transport company and the manufacturer should be contacted.

The material received should also be checked in order to ascertain that it coincides with the order.

If the protection is not to be used immediately, it should be stored in its original packaging in a dry and dust-free location.

The protection units must be transported in their original packaging.

1.79 CONNECTION

The protections must be connected in accordance with the enclosed external connection diagram. This is a general diagram. The individual programming of inputs and outputs should be taken into consideration in each specific case.

Auxiliary power supply

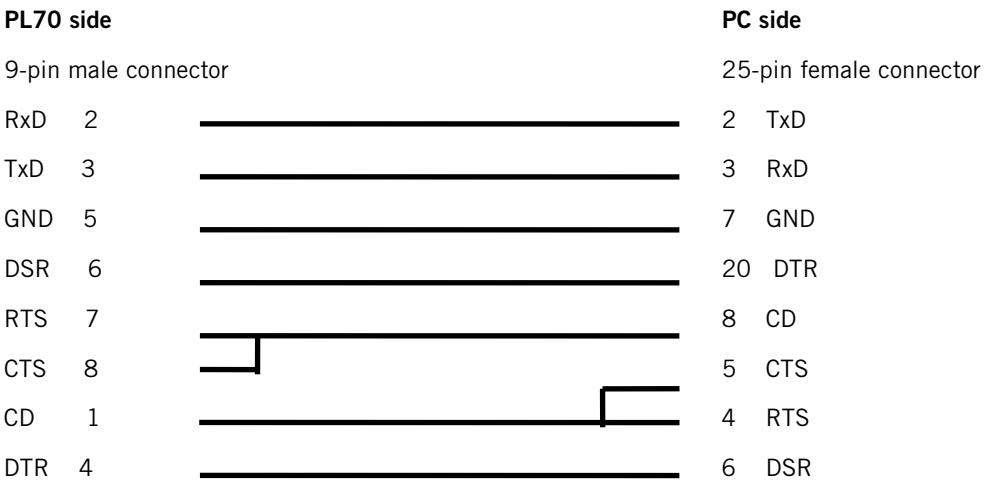
The polarity is indifferent.

Earth connection

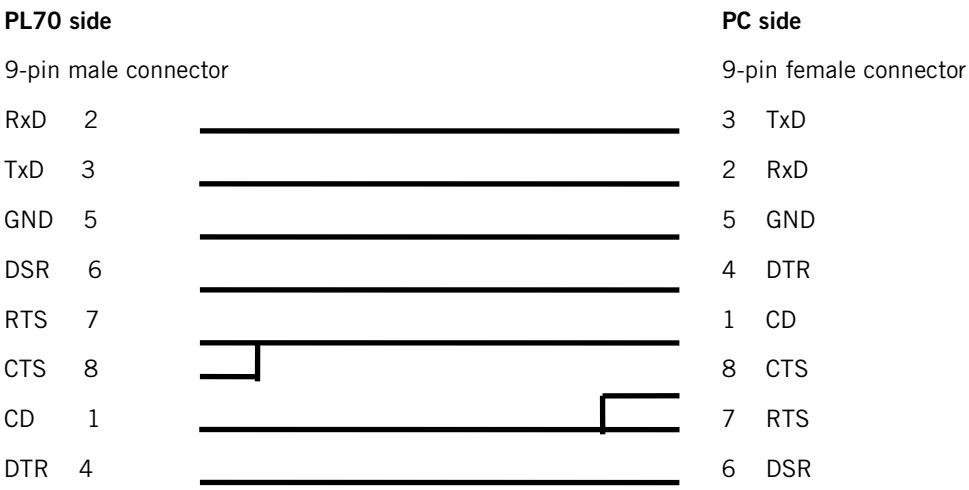
The earth connection must be effected correctly in order that the protection's disturbance rejection devices function correctly. The connection must be as short as possible (less than 25 cm.), using multiwired, 4 mm^2 section cable.

RS232 cable connections to be used between the PC and the PL70

Case 1: 25 pin PC output connector.



Case 2: 9-pin PC output connector.



1.80 UNIT ADDRESSING

See the “Communications configuration” section.

1.81 START-UP

The PL70 protections are supplied with the default factory settings.

Before start-up, the units must be set via the keyboard/display and/or PC with the correct values and following the procedures indicated.

The protection has been checked at the factory in order to guarantee the accuracy of the different parameter settings points. However, the testing of various points during reception and start-up is recommended in order to ensure that the protection is fully operative.

Once the line is connected, the relay’s real measurements can be consulted in order to check their correct connection and operation.

APPENDIX I. KEYBOARD / DISPLAY (BLOCKS OF CURRENT FAMILIES)

In the following pages we enclose a table which graphically illustrates and shows the easy handling of the different menus and settings which can be changed with the keyboard/display. We recommend this appendix be at hand when you start to use the keyboard, in order to easily find the settings to be changed.

The structure is generic for the whole family of PL70, corresponding to current units, that is, it does not correspond to a certain model, but to IT, IS, IM, IA, ID, IP, IV MO and FI families. In each model the settings and measurements corresponding to its available functions will only appear.

DATE/TIME (see)		Units date and time are visualized.
SEE ACTIVE TABLE		Present active table
DIG. INPUT	INP. STAT	Status of inputs 1 and 2
	(1 and 2)	Status of inputs 1 and 2
	(3 and 4)	Status of inputs 3 and 4
	(5 and 6)	Status of inputs 5 and 6
	(7 and 8)	Status of inputs7 and 8
DIG. OUT	OUT.STAT.	
	(1 and 2)	Status of outputs 1 and 2
	(3 and 4)	Status of outputs 3 and4
	(5 and 6)	Status of outputs 5 and 6
	(7 and 8)	Status of outputs 7 and 8
	(9 and 10)	Status of outputs9 and10
	(11)	Status of output11
MEASURES	See page 4	
STATIST. DATA	See page 4	
LAST FAULTS	See page 4	
SETPOINTS (read)	See page 6	
SETPOINTS (change)	See page 15	
RECLOSER ON/OFF		Recloser On /Off

MEASUREMENTS	SECONDARY MEASUR	Pha.A	Phase A current.
		Pha.B	Phase B current
		Pha.C	Phase C current
		GND	Neutral current
		S. GND	Sensitive neutral current
		IsG C	Neutral isolated current
		IsG V	Neutral isolated voltage
		.Res C	Residual current
		N 2 C	Ground current 2
		N 3 C	Ground current 3
		MAX. (A)	Maximum average current in an interval t
		(%) NEG SEQ	Reverse component (%)
	PRIMARY MEASURES	Pha.A	Phase A current.
		Pha.B	Phase B current
		Pha.C	Phase C current
		GND	Neutral current
		S. GND	Sensitive neutral current
		IsG C	Neutral isolated current
		IsG V	Neutral isolated voltage
		MAX. (A)	Maximum average current in an interval t
	AUXIL. MEASURES	Vsup 3, 3V	Supply internal measurement 3.3V
		Vbat3, 3V	Battery internal measurement 3.3V
		Extern V	Supply external measurement
		TEMP (ºC)	Unit temperature (ºC)
	THER. IMAG		Thermal image temperature
STATIS. DATA	TOT REC		Total number of reclosures.
	FIRS REC		Number of first reclosures.
	SECO REC		Number of second reclosures.
	THIR REC		Number of third reclosures.
	FOUR REC		Number of fourth reclosures.
	OPEN No.		Total number of trips given by the protection.
	KI2 P(A)		KI2 sum for maintenance, phase A
	KI2 P(B)		KI2 sum for maintenance, phase B
	KI2 P(C)		KI2 sum for maintenance, phase C
LAST FAULTS	FAULT n	TYPE	Phase/s involved in the last fault.
		Fau Ph A	Phase A current when the fault occurred (S).
		Fau Ph.B	Phase B current when the fault occurred (S).
		Fau Ph.C	Phase C current when the fault occurred (S).).
		Faul GND	Neutral current when the fault occurred (S)
		Fa S GND	Sensitive neutral current when the fault ocurred (S).
		Fau Res.	Residual current when the fault occurred (S).
		Faul.G2	Neutral 2 current when the fault occurred (S).
		Faul.G3	Neutral 3 current when the fault occurred (S).)
		F IsGND	Isolated neutral current when the fault occurred (S)
		Vo IsGND	Isolated neutral voltage when the fault occurred (S)
		START T	Fault start date and time.
		END T	Fault end date and time.
		LedReset	Fault acknowledgement to switch off the Led.
		TEMP.=0?	Trip acknowledgement by thermal image

SETPOINTS (see)	TABLE 1 (see)	PROTECT	PHASES TOC	ENABLED		Phase TOC
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				ENABL ACCELE.		
				BLOCKING		
			GROUND TOC	ENABLED		Ground TOC
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		
			RESIDUAL TOC	ENABLED		Residual current TOC
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		
			G SENS TOC	ENABLED		Sensitive ground TOC
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		
			PHASES IOC	ENABLED		Phase IOC (low level)
				PICKUP		
				FIX TIME		
				BLOCKING		
			GROUND TOC	ENABLED		Ground IOC (low level)
				PICKUP		
				FIX TIME		
				BLOCKING		

SETPOINTS (see)	TABLE 1 (see)	PROTECT	RESIDUAL IOC	ENABLED		Inst. Int. Residual
				PICKUP		
				FIX TIME		
				BLOCKING		
			G SENS IOC	ENABLED		Sensitive ground instant
				PICKUP		
				DEF. TIME		
				BLOCKING		
			IMAGE TERMIC	PARAMS	ENABLE	Thermal image
					HEAT. CO.	
					RE. CONST	
					AL. THRES	
					BLOCKING	
				PICK. C		
			NEGATIVE SEQUENCE	ENABLED		Broken conductor
				PICKUP		
				DEF. TIME		
				BLOCKING		
			UNBALAN.TOC	ENABLED		Current unbalance time
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		
			UNBALAN.IOC	ENABLED		Current unbalan instant.
				PICKUP		
				DEF. TIME		
				BLOCKING		

			HIGH IOC	HIGH IOC PHA	ENABLED	Phase instantaneous High 1
					PICKUP	
					DEF. TIME	
					BLOCKING	
				HIGH IOC GND	ENABLED	Ground instantaneous High 1
					PICKUP	
					DEF. TIME	
					BLOCKING	
				HIGH IOC SGND	ENABLED	Sen.ground instant.s High 1
					PICKUP	
					DEF. TIME	
SETPOINTS (see)	TABLE 1 (see)	PROTECT	DIRECT.	DIR. ANG	Directional protection	
				POLAR. V.		
				P BLOCK		
				ZONE WID		
				BLOCKING		
			IS. GND	ENABLED	Isolated ground	
				TRQ. CTROL		
				CURR. LOW		
				CURR. HIG		
				VOLT. LOW		
				VOLT. HIGH		
				T.1ST TR		
				SWI.INST		
				BLOCKING		
			GR TOC 1	ENABLED	Ground TOC 1	
				PICKUP		
				CURVES		
				INDEX		
				FIX TIME		
				BLOCKING		
			GR TOC 2	ENABLED	Ground TOC 2	
				PICKUP		
				CURVES		
				INDEX		
				FIX TIME		
				BLOCKING		
			GR IOC 1	ENABLED	Ground IOC 1	
				PICKUP		
				DEF. TIME		
				BLOCKING		
			GR IOC 2	ENABLED	Ground IOC 2	
				PICKUP		
				DEF. TIME		
				BLOCKING		

SETPOINTS (see)	TABLE 1 (see)	PROTECT	BREAKER FAILURE	ENABLED	Breaker failure
				PH. DROP	
				GND. DROP	
				DEF. TIME	
				BLOCKING	
			ROTOR LOCKED	ENABLED	Enable YES/NO
				PICKUP	Pick up current
				DEF. TIME	Definite time
				BLOCKING	
			IDLE RUNNING	ENABLED	Enable YES/NO
				PICKUP	Pick up current
				DEF. TIME	Definite time
				BLOCKING	
			LONG PICK UP	ENABLED	Enable YES/NO
				PICK TIM	Pick up TIME
				BLOCKING	
			SUCESSIV PICKUPS	ENABLED	Enable YES/NO
				PICK NUM	Pickup number
				TIME WIN	Time window
				OP. ACT. T	Output activation time
				BLOCKING	
			RESTRIC GND.	ENABLED	Enable YES/NO
				PICKUP	Pick up current
				DEF. TIME	Definite time
				BLOCKING	
			UNDERCURR. 2 LEVELS	ENABLED	
				PICK-UP L1	Pickup current level 1
				F.TYPE L1	Definite time level 1
				PICK-UP L2	Pickup current level 2
				F.TYPE L2	Definite time level 2

SETPOINTS (see)	TABLE 1 (see)	PROTECT	BREAKER FAILURE	OPERATION MODE		Family Breaker failure, oper. mode I
				TRIP BY FAULT	HABILIT. MODE	Type of enabling in trip due to fault
					TRIP SIGNA	Trip signal
					52 TOPOLOGY	Topology 52
					PH. DROP	Phase restoration (A)
					GND. DROP	Neutral restoration (A)
					RETRIP T	Retrip definite time (sec.)
					TRIP T	Trip definite time (sec.)
					BLOCKING	
				OPEN.WITH CHARGE	HABILITATED	Enabling to the opening with load
					CHARG THRES	Load threshold (A)
					CHG. FAL T1	Definite time failure in load 1 (sec.)
					CHG. FAL T2	Definite time failure in load 2 (sec.)
				INTERN.ARCH DET	INTERN.ARCH DET	Rear arch detection enabling
					INT.ARCH PICKUP	Rear arch pick up (A)
					INTERN.ARCH TIME	Rear arch time(sec.)
				DEAD ZONE	ENABLED	Dead zone enabling
					DEAD Z.THR	Dead zone threshold (A)
					DEAD Z.TIM	Dead zone definite time (sec.)
					BLOCKING	
				LOW CHAR/GND	L.C/N.EN	En. breaker failure in low load or grnd
					B.T. PER	Two-trip permission trip
					N. DET.EN	Enabling detection by ground
					N.C.THR	Ground current threshold (A)
					RETRIP T	Retrip time (sec.)
					TRIP SIGNAL	Trip signal
					BLOCKING	
			PHAS.TOC LIMITAT.	PTOC BLK		Phase TOC block

GND TOC LIMITAT.	LIM.CUR.		Limit current
	GTOC BLK		Neutral TOC block
SGND TOC LIMITAT.	LIM.CUR.		Limit current
	TOC BLK		Sensitive Neutral TOC block

SETPOINTS (see)	TABLE 1 (see)	PROTECT	PHS TOC HIGH2	ENABLED	Phase TOC High2
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			GND TOC HIGH2	ENABLED	Ground TOC High2
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			SGND TOC HIGH2	ENABLED	Sensitive Ground TOC High2
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			PHS IOC HIGH2	ENABLED	Phase IOC High2
				PICKUP	
				FIX TIME	
				BLOCKING	
			GND IOC HIGH2	ENABLED	Ground IOC High2
				PICKUP	
				FIX TIME	
				BLOCKING	
			SGND IOC HIGH2	ENABLED	Sensitive Ground IOC High2
				PICKUP	
				FIX TIME	
				BLOCKING	

SETPOINTS (see)	TABLE 1 (see)	RECLOS	RECLOSER. ON/OFF	RECLO.ON	Recloser in service/out of service.
			RECLOSE	T. RE1, P	1st closure time for phase to phase faults.
				T. RE1,T	1st closure time for phase to earth faults.
				T. RE2,P	2nd closure time for phase to phase faults.
				T. RE2,T	2nd closure time for phase to earth faults.
				T. RE3,P	3rd closure time for phase to phase faults.
				T. RE3,T	3rd closure time for phase to earth faults.
				T. RE4,P	4th closure time for phase to phase faults.
				T. RE4,T	4th closure time for phase to earth faults.
			DIVERSE TIMES	WAIT.Vref	Voltage reference waiting time.
				S.P.F.T	Reclaim time for faults.
				S.G.F.T	Reclaim time for GND.
				S.M.CL.T	Security time after manual closing.
			CYCLE CONTROL	RECL.NUM	No. of closures allowed.
			TRIP ENABLE	AT REST	Trip permission at rest
				Af.REC.1	Trips allowed after first reclosure.
				Af.REC.2	Trips allowed after second reclosure.
				Af.REC.3	Trips allowed after third reclosure.
				Af.REC.4	Trips allowed after fourth reclosure.
				Af.M.CL	Trips allowed after manual closure.
			RECLOSE ENABLE	Af.P.TOC	Allowed recl. after tripping due to phase toc.
				Af.G.TOC	Allowed recl. after tripping due to neutral toc.
				A.SG.TOC	Allowed recl. after tripping due to sensitive neutral toc.
				RES.TOC	Allowed recl. after tripping due to residual current toc.
				Tr.IOC F	Allowed recl. after tripping due to phase ioc

				Af.G.IOC	Allowed recl. after tripping due to neutral ioc.
				RES.IOC	Allowed recl. after tripping due to res. current ioc
				A.SG.IOC	Allowed recl. after tripping due to sens. neutral ioc
				F.H.IOC	Allowed recl. after tripping due to High phases instant.
				N.H. IOC	Allowed recl. after tripping due to High neutral instant
				Af.OP.PH	Allowed recl. after tripping due to Broken Conductor
				Af.EXT.P	Allowed recl. after external actuation
			RECLOS SEQ.CORD	ENABLED	Sequence coordination
			RECLOSERBLOCK.C.		Recloser locking conditions.

SETPOINTS (see)	TABLE 1 (see)	BREAKER	EX.TR.N.		Excessive number of trips.
			WI.TR.N		Time for counting excessive number of trips
			AlarmKI2		KI2 sum alarm for maintenance.
			Init KI2		Initial KI2 sum(settings).
			E.T.C.SV		Trip circuit monitoring enable.
			E.C.C.SV		Close circuit monitoring enable.
		OPERAT	TRIP LATCH		Trip locking.
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (see)	SAME AS TABLE			
	TABLE 3 (see)	SAME AS TABLE 1			
	TABLE 4 (see)	SAME AS TABLE 1			

SETPOINTS (see)	TABLE 1 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration	
				SELECT NO/NC		
				INPUTS ACTIV.TI	Input filter	
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)	
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI		
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)	
		GENERAL.	PH.RATIO		Phase current transformatio ratio	
			GNDRATIO		Ground current transformatio ratio.	
			R.T.SGND		Sensistive ground current transformatio ratio.	
			LANGUAGE		Spanish/English	
			FAULT.M.		Primary/Secondary	
		SPECIAL	PH ORDER		A-B-C / C-B-A	
			FREQUEN.		50 / 60 Hz	
			FEEDING SUPERVI.		Enable feeding supervision	
			PHASES P	PHS.B C.	MEASURE / CALCULATED	IS and IT family
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103	
			FRONT	ADDRESS	Protection address	
				BAUD RATE	Baud rate (bauds).	
				PARITY	Parity (par) yes or no.	
				STOP BIT	Number of STOP BITS	
			BACK	ADDRESS	Protection address.	
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).	
				PARITY	Parity (par) yes or no.	
				STOP BIT	Number of STOP BITS	
				CTRL. SIG	RTS signal	
			BACK	ADDRESS	UCL address for DNP communications	
			(if DNP programmed)	MAST. AD	Master address for DNP communications	
				BAUD RATE	Baud rate in DNP communications	
				PARITY	Parity in DNP communications	
				STOP BIT	STOP BIT for DNP communications	
				FIX.RTS	YES/NO	
				COMMS C	RTS and CTS control for DNP communications	
				CTS W.T	CTS waiting time for DNP communications(csec.)	
				POR.W.T	CARRIER waiting time for DNP communications(csec.)	
				STAB. T	Stabilization time for DNP communications(csec.)	
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).	
				SYNC. T	Synchronixation time for DNP communications(csec.)	
				ACK LINK	Link acknowledge for DNP c	
				BYT.AP.N	Number of application messages bytes for DNP	
				CHANG.T.	Change sending time for DNP communications	
				FROZ.T.	Counter freezing time for DNP	
				STAT.S.	Status sending for DNP communications	
				MEAS.B.N	Measurement format for DNP communications	
				COUN.B.N	Counter format for DNP communications	
				N.R.MSG	Non requested messages sending for DNP	
				PR.COLL	Collision prevision for DNP communications	
				COL.F. T",	Definite collsision time for DNP communications(csec.)	
				COL.V. T",	T. de colisión variable for DNP (csec.)	
				RESEND T	T. de reenvío de msgs. no pedidos for DNP	
				N.R.MAX	Num. máx. mensajes no pedidos for DNP	
				"ESPECIAL	Especial for DNP communications	
				FORMAT	UCL address for DNP communications	
				POSTTR. T.	Posttransmission time	
			BACK	ADDRESS	UCL address	
			(if MODBUS programmed)	BAUD RATE	Baud rate	
				PARITY	Parity	
				T.AC.RTS	RTS activation waiting time	
				T.CARRIE	Carrier waiting time	
				T.DE.RTS	RTS deactivation waiting time	
				FORMAT	Format for MODBUS	
			BACK	ADDRESS	UCL address	

	(if 103 programmed)	BAUD RATE	Baud rate in DNP communications		
		PARITY	Parity in DNP communications		
		STOP BITS	Number of STOP. BIT.		
		RTS ACT.	RTS activation waiting time		
		CARRIER	Carrier waiting time		
		RTS DIS.	RTS deactivation waiting time		
		DATA FOR	Compatible VDEW/Extended		
	TCP/IP	SEE COM TCPIP	TCPIP P.		See TCP/IP communications (NO, PROCOME)
		SEE PAR TCPIP	PROCOME PARAM.		ADDRESS

SETPOINTS (see)	TABLE 1 (see)	SPECIAL PROTEC	V.CTRL.(51V)	CTRLV	V CTRL	Voltage control
					.CTRLV	
				PHASE TOC	PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
			COLD LOAD	COLDLOAD PICKUP	ENABLED	
					C.L.D.T	Cold load detection time
					C.L.A.T	Cold load activation time
				PHASES TOC	ENABLED	Cold Load Pickup
					PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
					BLOCKING	
				GROUND TOC	ENABLED	
					PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
					BLOCKING	
				PHASES IOC	ENABLED	
					PICK UP	
					DEF. TIME	
					BLOCKING	

SETPOINTS (see)	TABLE 0 (see)	PROTECTIONS	COLDLOAD PICKUP	GROUND IOC	ENABLED	Cold Load Pickup
					PICK UP	
					DEF. TIME	
					BLOCKING	
				SENS GROUND TOC	ENABLED	
					PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
					BLOCKING	
				SENS GROUND IOC	ENABLED	
					PICK UP	
					DEF. TIME	
					BLOCKING	
SETPOINTS(change)	DATE/ TIME (change)					
Enter KEYWORD	ACTIVATE TABLE	TABLE 1 ?				Make table 1 active
↑↑↓↓		TABLE 2 ?				Make table 2 active
		TABLE 3?				Make table 3 active
		TABLE 4?				Make table 4 active
SETPOINTS(change)	TABLE 1 (change)	PROTECTION	PHASE TOC	ENABLED		Phases time
				PICKUP		
				CURVE		
				TIME DIAL		
				FIX TIME		
				ENABL ACCELE.		
				BLOCKING		Ground time
			GND TOC	ENABLED		

				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		Residual current time
			RESIDUAL TOC	ENABLED		
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		Sensitive ground time
			G SENS TOC	ENABLED		
				PICKUP		
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		
			PHASES IOC	ENABLED		Phase instantaneous (low level)
				PICKUP		
				FIX TIME		
				BLOCKING		
			GROUND TOC	ENABLED		Ground instantaneous (low level)
				PICKUP		
				FIX TIME		
				BLOCKING		

SETPOINTS(change)	TABLE 1 (change)	PROTECTION	RESIDUAL IOC	ENABLED		Reidual current instant
				PICKUP		
				FIX TIME		
				BLOCKING		
			G SENS IOC	ENABLED		Sen. neutral instantaneous
				PICKUP		
				DEF. TIME		
				BLOCKING		
			IMAGE TERMIC	PARAMS	ENABLE	Enable
					HEAT. CO.	Heating constant
					RE. CONST	Cooling constant
					AL. THRES	Alarm threshold
					BLOCKING	Restore threshold
				PICK C		
			NEGATIVE SEQUENCE	ENABLED		
				PICKUP		Broken conductor
				DEF. TIME		
				BLOCKING		
			UNBALANCE TOC	ENABLED		
				PICKUP		Current unbalance time
				CURVE		
				INDEX		
				FIX TIME		
				BLOCKING		
			UNBALANCE IOC	ENABLED		
				PICKUP		Current unbalance instant.
				DEF. TIME		
				BLOCKING		
			HIGH IOC	HIGH IOC PHA	ENABLED	Phase High instantaneous
					PICKUP	
					DEF. TIME	
					BLOCKING	
				HIGH IOC GND	ENABLED	Neutral High instantaneous
					PICKUP	
					DEF. TIME	
					BLOCKING	
				HIGH IOC SGND	ENABLED	Sensistive neutral High instant.
					PICKUP	
					DEF. TIME	

SETPOINTS(change)	TABLE 1 (change)		PROTECTION	DIRECC.	DIR. ANG	Directional protection
					POLAR. V.	
					P BLOCK	
					ZONE WID	
					BLOCKING	
				IS. GND	ENABLED	Isolated neutral
					TRQ. CTROL	

		CURR. LOW	
		CURR. HIG	
		VOLT. LOW	
		VOLT. HIGH	
		T.1ST TR	
		SWI.INST	
		BLOCKING	
	GR TOC 1	ENABLED	Neutral 1 Time
		PICKUP	
		CURVES	
		INDEX	
		FIX TIME	
		BLOCKING	
	GR TOC 2	ENABLED	Neutral 2 Time
		PICKUP	
		CURVES	
		INDEX	
		FIX TIME	
		BLOCKING	
	GR IOC 1	ENABLED	Neutral 1 instantaneous
		PICKUP	
		DEF. TIME	
		BLOCKING	
	GR IOC 2	ENABLED	Neutral 2 instantaneous
		PICKUP	
		DEF. TIME	
		BLOCKING	

SETPOINTS(change)	TABLE 1 (change)	PROTECTION	BREAKER FAILURE	ENABLED	Breaker failure
				PH. DROP	
				GND. DROP	
				DEF. TIME	
				BLOCKING	
			ROTOR LOCKED	ENABLED	Enable YES/NO
				PICKUP	Pick up current
				DEF. TIME	Definite time
				BLOCKING	
			IDLE RUNNING	ENABLED	Enable YES/NO
				PICKUP	Pick up current
				DEF. TIME	Definite time
				BLOCKING	
			LONG PICK UP	ENABLED	Enable YES/NO
				PICK TIM	Pick up time
				BLOCKING	
			SUCESSIV PICKUPS	ENABLED	Enable YES/NO
				PICK NUM	Number of pick ups
				TIME WIN	Time window
				OP. ACT. T	Output activation time
				BLOCKING	
			UNDERCURR. 2 LEVELS	ENABLED	
				PICK-UP L1	Pickup current level 1
				F.TYPE L1	Definite time level1
				PICK-UP L2	Pickup current level 2
				F.TYPE L2	Definite time level 2

SETPOINTS(change)	TABLE 1 (change)	PROTECTION	BREAKER FAILURE	OPERATION MODE		Family Breaker failure, operat. mode I
				TRIP BY FAULT	HABILIT. MODE	Type of enabling in trip due to fault
					TRIP SIGNA	Trip signal
					52 TOPOLOGY	Topology 52
					PH. DROP	Phase restoration (A)
					GND. DROP	Neutral restoration (A)
					RETRIP T	Retrip definite time (sec.)
					TRIP T	Trip definite time (sec.)
					BLOCKING	
				OPEN.WITH CHARGE	ENABLED	Enabling to the opening with load
					CHARG THRES	Load threshold (A)
					CHG. FAL T1	Definite time failure in load 1 (sec.)
					CHG. FAL T2	Definite time failure in load 2 (sec.)
				INTERN.ARCH DET	ENABLED	Rear arch detection enabling
					INT.ARCH PICKUP	Rear arch pick up (A)
					INTERN.ARCH TIME	Rear arch time(sec.)
				DEAD ZONE	ENABLED	Dead zone enabling
					DEAD Z.THR	Dead zone threshold (A)
					DEAD Z.TIM	Dead zone definite time (sec.)
					BLOCKING	
				LOW CHAR/GND	L.C/N.EN	En. breaker failure in low load or gnd
					B.T. PER	Two-trip permission trip
					N. DET.EN	Enabling detection by ground
					N.C.THR	Ground current threshold (A)
					RETRIP T	Retrip time (sec.)
					TRIP SIGNAL	Trip signal
					BLOCKING	
			PHAS.TOC LIMITAT.	PTOC BLK		Phase TOC block
			GND TOC LIMITAT.	LIM.CUR.		Limit current
				GTOC BLK		Neutral TOC block
			SGND TOC LIMITAT.	LIM.CUR.		Limit current
				TOC BLK		Sensitive Neutral TOC block

SETPOINTS(change)	TABLE 1 (change)	PROTECT	PHS TOC HIGH2	ENABLED	Phase TOC High2
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			GND TOC HIGH2	ENABLED	Ground TOC High2
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			SGND TOC HIGH2	ENABLED	Sensitive Ground TOC High2
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			PHS IOC HIGH2	ENABLED	Phase IOC High2
				PICKUP	
				FIX TIME	
				BLOCKING	
			GND IOC HIGH2	ENABLED	Ground IOC High2
				PICKUP	
				FIX TIME	
				BLOCKING	
			SGND IOC HIGH2	ENABLED	Sensitive Ground IOC High2
				PICKUP	
				FIX TIME	
				BLOCKING	

SETPOINTS(change)	TABLE 1 (change)	RECLOSER	RECLOSER. ON/OFF	RECLO.ON	Recloser on/off
			RECLOS. TIME	T. RE1, P	Recloser 1st for faults among phases
				T. RE1,T	Recloser 1st for faults to ground
				T. RE2,P	Recloser 2nd for faults among phases
				T. RE2,T	Recloser 2nd for faults to ground
				T. RE3,P	Recloser 3rd for faults among phases
				T. RE3,T	Recloser 3rd for faults to ground
				T. RE4,P	Recloser 4th for faults among phases
				T. RE4,T	Recloser 4th for faults to ground
			DIVERSE TIMES	WAIT.Vref	Reference voltage waiting time
				S.P.F.T	Security time for faults
				S.G.F.T	Security time for GND.
				S.M.CL.T	Security time after manual close.
			CYCLE CONTROL	RECL.NUM	Number of permitted reclosers.
			TRIP ENABLE	AT REST	Permitted trips at rest
				Af.REC.1	Permitted trips after first recloser
				Af.REC.2	Permitted trips after second recloser
				Af.REC.3	Permitted trips after third recloser
				Af.REC.4	Permitted trips after fourth recloser.
				Af.M.CL	Permitted trips after manual close.
			RECLOSE ENABLE	Af.P.TOC	Allowed reclosures after tripping due to phase toc.
				Af.G.TOC	Allowed reclo. after tripping due to neutral toc.
				A.SG.TOC	Allowed reclo. after tripping due to sensitive neutral toc.
				RES.TOC	Allowed reclo. after tripping due to residual current toc.
				Tr.IOC F	Allowed reclo. after fter tripping due to phase ioc.
				Af.G.IOC	Allowed reclo. after tripping due to neutral ioc.
				RES.IOC	Allowed reclo. after tripping due to residual current ioc
				A.SG.IOC	Allowed reclo. after tripping due to sensitive neutral ioc
				F.H.IOC	Allowed reclo. after tripping due to High phases instant.
				F.N. IOC	Allowed reclo. after tripping due to High neutral instant
				Af.OP.PH	Allowed reclo. after tripping due to Broken Conductor

				Af.EXT.P	Allowed reclo. after external actuation
			RECLOS SEQ.CORD	ENABLED	Sequence coordination
			RECLOSER BLOCK.C.		Recloser locking conditions.

SETPOINTS(change)	TABLE 1 (change)	BREAKER	EX.TR.N.		Excessive number of trips.
			WI.TR.N		Time due to excessive number of trips.
			AlarmKI2		Alarm sigma KI2 for maintenance
			Init KI2		Initial sigma KI2(setting).
			E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OPERAT	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (see)	SAME AS TABLE 1			
	TABLE 3 (see)	SAME AS TABLE 1			
	TABLE 4 (see)	SAME AS TABLE 1			

SETPOINTS(change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration	
				SELECT NO/NC		
				INPUTS ACTIV.TI	Input filter	
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)	
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI		
			LEDs	LED 1 to LED 7	Conf. of the 7 program. leds (function and type)	
		GENERAL.	PH.RATIO		Phase current transformatio ratio	
			GND RATIO		Ground current transformatio ratio.	
			R.T.SGND		Sensistive ground current transformatio ratio.	
			LANGUAGE		Spanish/English	
			FAULT MEASURE		Primary/Secondary	
		SPECIAL	PH ORDER		A-B-C / C-B-A	
		Enter keyword ↑↓.┘┘	FREQUEN.		50 / 60 Hz	
			CAL SET		For exclusive use of INGETEAM Technology	
			DELETES?		Reset the events, faults and oscillo queues	
			PHASES P	PHS.B C.	MEASURE / CALCULATED	IS and IT family
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103	
			FRONT	ADDRESS	Protection address	
				BAUD RATE	Baud rate (bauds).	
				PARITY	Parity (par) yes or no.	
				STOP BIT	Number of STOP BITS	
			BACK	ADDRESS	Protection address.	
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).	
				PARITY	Parity (par) yes or no.	
				STOP BIT	Number of STOP BITS	
				CTROL SIG	RTS signal	
			BACK	ADDRESS	UCL address for DNP communications	
			(if DNP programmed)	MAST. AD	Master address for DNP communications	
				BAUD RATE	Baud rate in DNP communications	
				PARITY	Parity in DNP communications	
				STOP BIT	STOP BIT for DNP communications	
				FIX.RTS	YES/NO	
				COMMS C	RTS and CTS control for DNP communications	
				CTS W.T	CTS wait. time for DNP communications(csec.)	
				POR.W.T	CARRIER wait. time for DNP communic.(csec.)	
				STAB. T	Stabilization time for DNP communic.(csec.)	
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).	
				SYNC. T	Synchronixation time for DNP communications(csec.)	
				ACK LINK	Link acknowledge for DNP c	
				BYT.AP.N	Number of application messages bytes for DNP	
				CHANG.T.	Change sending time for DNP communications	
				FROZ.T.	Counter freezing time for DNP	
				STAT.S.	Status sending for DNP communications	
				MEAS.B.N	Measurement format for DNP communications	
				COUN.B.N	Counter format for DNP communications	
				N.R.MSG	Non requested messages sending for DNP	
				PR.COLL	Collision prevision for DNP communications	
				COL.F. T",	Def. collision time for DNP communic.(csec.)	
				COL.V. T",	T. de colisión variable for DNP (csec.)	
				RESEND T	T. de reenvío de msgs. no pedidos for DNP	
				N.R.MAX	Num. máx. mensajes no pedidos for DNP	
				"ESPECIAL	Sspecial for DNP communications	
				FORMAT	UCL address for DNP communications	
				POSTTR T.	Posttransmission time	
			BACK	ADDRESS	UCL address	
			(if MODBUS programmed)	BAUD RATE	Baud rate	
				PARITY	Parity	
				T.AC.RTS	RTS activation waiting time	
				T.CARRIE	Carrier waiting time	
				T.DE.RTS	RTS deactivation waiting time	
				FORMAT	Format for MODBUS	
			BACK	ADDRESS	UCL address	

	(if 103 programmed)	BAUD RATE	Baud rate in DNP communications		
		PARITY	Parity in DNP communications		
		STOP BITS	Number of STOP. BIT.		
		RTS ACT.	RTS activation waiting time		
		CARRIER	Carrier waiting time		
		RTS DIS.	RTS deactivation waiting time		
		DATA FOR	Compatible VDEW/Extended		
	TCP/IP	TCPIP COM SELEC	TCPIP P.	Select TCP/IP communications (PROCOME, NO)	
		PG.TCPIP PARAM	PROCOME PARAM.	ADDRESS	

SETPOINTS(change)	TABLE 0 (change)	PROTECTIONS ESPECIALES	V CNTRL (51V)	PA.CTRLV	ENABLE	Voltage control
					V CNTRL	
				PHASE TOC	PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
			COLD LOAD	COLDLOAD PICKUP	ENABLED	
					C.L.D.T	Cold Load detection time
					C.L.A.T	Cold Load activation time
				PHASES TOC	ENABLED	Cold Load Pickup
					PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
					BLOCKING	
				GROUND TOC	ENABLED	
					PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
					BLOCKING	
				PHASES IOC	ENABLED	
					PICK UP	
					DEF. TIME	
					BLOCKING	

SETPOINTS(change)	TABLE 0 (change)	PROTECTIONS ESPECIALES	COLDLOAD PICKUP	GROUND IOC	ENABLED	Cold Load Pickup
					PICK UP	
					DEF. TIME	
					BLOCKING	
				SENS GROUND TOC	ENABLED	
					PICK UP	
					CURVE	
					TIME DIAL	
					DEF. TIME	
					BLOCKING	
				SENS GROUND IOC	ENABLED	
					PICK UP	
					DEF. TIME	
					BLOCKING	
	COUNTER SETTINGS	OPEN= 0?				Set opening counters to zero
		RECLOSE COUNT= 0 ?				Set reclosure and trip counters to zero
		MAX. =0?				Set maximeter to zero.
		KI2=INI. ?				Initialize KI2 sum to its setting value.

APPENDIX II. KEYBOARD / DISPLAY (BLOCK OF VOLTAGE FAMILIES)

In the following pages we enclose a table which graphically illustrates and shows the easy handling of the different menus and settings which can be changed with the keyboard/display. We recommend this appendix be at hand when you start to use the keyboard, in order to easily find the settings to be changed.

The structure is generic for the whole family of PL70, corresponding to current units, that is, it does not correspond to a certain model, but to TT, SV, TF, TH and SY families. In each model the settings and measurements corresponding to its available functions will only appear.

DATE/TIME (see)		Units date and time are visualized.
SEE ACTIVE TABLE		Present active table
DIG. INPU	INP. STAT	Status of inputs 1 and 2
	(1 and 2)	Status of inputs 1 and 2
	(3 and 4)	Status of inputs 3 and 4
	(5 and 6)	Status of inputs 5 and 6
	(7 and 8)	Status of inputs7 and 8
DIG. OUT	OUT.STAT.	
	(1 and 2)	Status of outputs 1 and 2
	(3 and 4)	Status of outputs 3 and4
	(5 and 6)	Status of outputs 5 and 6
	(7 and 8)	Status of outputs 7 and 8
	(9 and 10)	Status of outputs9 and10
	(11)	Status of output11
MEASURES	See page 4	
STATIST. DATA	See page 4	
LAST FAULTS	See page 4	
SETPOINTS (read)	See page 6	
SETPOINTS (change)	See page 15	

MEASURES	SECONDARY MEASUR	Vol VA	Phase A voltage.
		Vol VB	Phase B voltage
		Vol VC	Phase C voltage
		Vol VN	Neutral voltage
		Mean. Vol	Mean voltage
		Rel. VAB	Compound voltage AB
		Rel. VBC (V)	Compound voltage BC
		Rel. VCA	Compound voltage CA
		Vcomp(V)	Mean compound voltage
	PRIMARY MEASURES	Vol VA(kV)	Phase A voltage in primary
		Vol VB(kV)	Phase B voltage in primary
		Vol VC(kV)	Phase B voltage in primary.
		Vol VN(kV)	Ground voltage in primary.
		Rel. VAB (kV)	AB in compound voltage in primary
		Rel. VBC (kV)	BC in compound voltage in primary
		Rel. VCA (kV)	CA in compound voltage in primary
		Mean Rel(kV)	Mean compound voltage in primary
	FREQUENCY		Frequeny (Hz)
	SYNCHRO. V.		Voltages sides A and B of synchronism
	SYNCHRO.FRQ		Frequencies sides A and B of synchronism
	ANGLE DIF.		Angle differences sides A and B of synchronism
	AUXIL. MEASURES	Vsup 3, 3V	Supply internal measurement 3.3V
		Vbat3, 3V	Battery internal measurement 3.3V
		Extern V	Supply external measurement
		TEMP (ºC)	Unit temperature (ºC)
STATIS. DATA	OPEN No.		Total number of trips given by the protection
LAST FAULTS	FAULT n	TYPE	Phase/s in which the last fault has occurred
		Faul.V.A	Voltage in phase A when the fault occurred (Sec).
		Faul.V.B	Voltage in phase B when the fault occurred (Sec).
		Faul.VB	Voltage in phase C when the fault occurred (Sec).
		Faul.V.N	Voltage in neutral when the fault occurred (Sec).
		Hz FAULT	Frequency when the fault occurred (Hz).
		START T	Fault start date and time.
		END T	Fault end date and time.
		LedReseT	Fault acknowledgement to switch off the Led.

SETPOINTS (see)	TABLE 1 (see)	PROTECT	OVERVOLT. TOV	ENABLED	Overvoltage time
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			OVERVOLT. IOV	ENABLED	Overvoltage Instantaneous
				PICKUP	
				TIME	
				BLOCKING	
			UNDERVOLT. TOV	ENABLED	Undervoltage time
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			UNDERVOLT. IOV	ENABLED	Undervoltage Instantaneous
				PICK UP	
				TIME	
				BLOCKING	
			TENSIÓN NEUTRO	ENABLED	Neutral voltage
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				PICK UP INST.	
				FIXED TIME	
				BLOCKING	
			VOLTAG UNBALANCE	ENABLED	
				PICKUP	
				FIX TIME	
				BLOCKING	
			NEGATIVE SEQUENCE	ENABLED	
				FIX TIME	
				BLOCKING	

SETPOINTS (see)	TABLE 1 (see)	PROTECT	FREQUENCY	FREQ. 1	ENABLED	Frequency step 1
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 2	ENABLED	Frequency step 2
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 3	ENABLED	Frequency step 3
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 4	ENABLED	Frequency step 4
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 5	ENABLED	Frequency step 5
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				BLOCKING		
			LOW VOLTAGE	MIN. V. S		Min.voltage of freq. supervision
				CYCLES N.		Number of pick up cycles
				DF/DT CYCLES		Number of df/dt cycles
			FREQUENCY GRADIENT	ENABLED		En. Freq. rate of change function
				SPV.F.1		Supervision frequency step 1
				F.GRAD 1		Frequency rate of change step 1
				FIX TIME 1		Definite time step 1
				SPV.F.2		Supervision frequency step 2
				F.GRAD 2		Frequency rate of change step 2
				FIX TIME 2		Definite time step 2
				SPV.F.3		Supervision frequency step 3
				F.GRAD 3		Frequency rate of change step 3
				FIX TIME 3		Definite time step 3
				SPV.F.4		Supervision frequency step 4
				F.GRAD4		Frequency rate of change step 4
				FIX TIME 4		Definite time step 4
				BLOCKING		
			OUT OF STEP	ENABLED.		
				ANGLE		
				MIN. V.		
				TRIP		
				BLOCKING		
			SYNCHRO	SI.CH.EN		En. synchronism general function
				SUBV.CO	!A and !B	Enable no voltage in A or B
					!A and B	Enable no voltage in A, but in B
					A and!B	Enable no voltage in B, but in A
				SI.CH.EN		Enable voltage difference
				A.DIF.EN		Enable angle difference
				F.DIF.EN		Enable frequency difference
				V.DIF.PU		Pick up voltage difference
				A.DIF.PU		Pick up angle difference
				F.DIF.P		Pick up frequency difference
				MIN. V A		Minimum voltage in A
				MIN. V B		Minimum voltage in B
				VA ABSEN		Lack of voltage in A
				VB ABSEN		Lack of voltage in B
				CL.CON.T		Close conditions timing
				BLOCKING		

SETPOINTS (see)	TABLE 1 (see)	PROTECT	LOW VOLTAGE	ENABLE	Enab. min. V function of synchronism
				S.A PICK	Pick up voltage side A
				S.B PICK	Pick up voltage side B
				FIX. TIME	Definite time
				BLOCKING	

SETPOINTS (see)	TABLE 1 (see)	BREAKER MONITOR	E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		RECL. FREQUENCY	ENABLED		Enable frequency recloser
			FREQ COND.		
			MIN FREQ		
			VOLT. COND		
			MIN. VOLTAGE		
			RECL TIME		
			SECU TIME		
			S.M.CL.T		
			ENAB. WAIT.T..		
			DDF. WAIT. T.		
			BLOCKING		
		OPERATION LOGIC	TRIP LAT		Trip latch
			OP.F.TIM		Open failure time
			CL.F.TIM		Close failure time
	TABLE 2 (see)	AS TABLE 1			
	TABLE 2 (see)	AS TABLE 1			
	TABLE 2 (see)	AS TABLE 1			

SETPOINTS (see)	TABLE 0 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL.	VOL.RAT		Voltage transformatio ratio
			NOM. VOLT		Nominal voltage
			IN V	TYPE V	Voltage input,voltage type (simples or compounds)
				MEAS.V	Voltage measurement
			LANGUAGE		Spanish/English
			FAULT.M.		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
			FREQUEN.		50 / 60 Hz
			FEEDING SUPERVI.		Enable feeding supervision
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG.	RTS signal
			BACK	ADDRESS	UCL address for DNP communications
			(if DNP programmed)	MAST. AD	Master address for DNP communications
				BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BIT	STOP BIT for DNP communications
				FIX.RTS	YES/NO
				COMMS C	RTS and CTS control for DNP communications
				CTS W.T	CTS waiting time for DNP communications(csec.)
				POR.W.T	CARRIER waiting time for DNP communications(csec.)
				STAB. T	Stabilization time for DNP communications(csec.)

		ACK.W.T	Link acknowledge waiting time for DNP(csec.).
		SYNC. T	Synchronixation time for DNP communications(csec.)
		ACK LINK	Link acknowledge for DNP c
		BYT.AP.N	Number of application messages bytes for DNP
		CHANG.T	Change sending time for DNP communications
		FROZ.T	Counter freezing time for DNP
		STAT.S.	Status sending for DNP communications
		MEAS.B.N	Measurement format for DNP communications
		COUN.B.N	Counter format for DNP communications
		N.R.MSG	Non requested messages sending for DNP
		PR.COLL	Collision prevision for DNP communications
		COL.F. T*,	Definite collsision time for DNP communications(csec.)
		COL.V. T*,	T. de colisión variable for DNP (csec.)
		RESEND T	T. de reenvío de msgs. no pedidos for DNP
		N.R.MAX	Num. máx. mensajes no pedidos for DNP
		*ESPECIAL	Sspecial for DNP communications
		FORMAT	UCL address for DNP communications
		POSTTR. T.	Posttransmission time
	BACK	ADDRESS	UCL address
	(if MODBUS programmed)	BAUD RATE	Baud rate
		PARITY	Parity
		T.AC.RTS	RTS activation waiting time
		T.CARRIE	Carrier waiting time
		T.DE.RTS	RTS deactivation waiting time
		FORMAT	Format for MODBUS
	BACK	ADDRESS	UCL address
	(if 103 programmed)	BAUD RATE	Baud rate in DNP communications
		PARITY	Parity in DNP communications
		STOP BITS	Number of STOP. BIT.
		RTS ACT.	RTS activation waiting time
		CARRIER	Carrier waiting time
		RTS DIS.	RTS deactivation waiting time
		DATA FOR	Compatible VDEW/Extended

SETPOINTS (change)	DATE/TIME (change)				
ENTER KEYWORD	ACTIVATE TABLE	TABLE1 ?			Make table 1 active.
↑↑↓↓		TABLE 2 ?			Make table 2 active..
		TABLE 3?			Make table 3 active.
		TABLE 4?			Make table 4 active.
SETPOINTS (change)	TABLE 1 (change)	PROTECTION	OVERVOLT TOV	ENABLED	Time overvoltage
				PICKUP	
				CURVE	
				INDEX	
				FIXED TIME	
				BLOCKING	
			OVERVOLT IOV	ENABLED	Instantaneous overvoltage
				PICKUP	
				TIME	
				BLOCKING	
			UNDERVOLT TUV	ENABLED	Time undervoltage
				PICKUP	
				CURVE	
				INDEX	
				FIXED TIME	
				BLOCKING	
			UNDERVOLT IUV	ENABLED	Instantaneous undervoltage
				PICKUP	
				TIME	
				BLOCKING	
			GROUND VOLT	ENABLED	Ground voltage
				PICKUP	
				CURVE	
				INDEX	
				FIXED TIME	
				IOC.PICK	
				INS.TIME	
				BLOCKING	

SETPOINTS (change)	TABLE 1 (change)	PROTECTION	VOLTAG UNBALANCE	ENABLED		
				PICKUP		
				FIX TIME		
				BLOCKING		
			NEGATIVE SEQUENCE	ENABLED		
				FIX TIME		
				BLOCKING		
			FREQUENCY	FREQ. 1	ENABLED	Frequency step 1
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 2	ENABLED	Frequency step 2
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 3	ENABLED	Frequency step 3
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 4	ENABLED	Frequency step 4
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				FREQ. 5	ENABLED	Frequency step 5
					PICK UP	Pick up frequency
					TIME	Time
					TYPE	Overfrequency/Underfrequency
				BLOCKING		
			LOW VOLTAGE	MIN. V. S		Min.voltage of freq. supervision
				CYCLES N.		Number of pick up cycles
				DF/DT CYCLES		Number of df/dt cycles
			FREQUENCY GRADIENT	ENABLED		Enable frequency rate of change function
				SPV.F.1		Supervision frequency step 1
				F.GRAD 1		Frequency rate of change step 1
				FIX TIME 1		Definite time step 1
				SPV.F.2		Supervision frequency step 2
				F.GRAD 2		Frequency rate of change step 2
				FIX TIME 2		Definite time step 2
				SPV.F.3		Supervision frequency step 3
				F.GRAD 3		Frequency rate of change step 3
				FIX TIME 3		Definite time step 3
				SPV.F.4		Supervision frequency step 4
				F.GRAD4		Frequency rate of change step 4
				FIX TIME 4		Definite time step 4
				BLOCKING		
			OUT OF STEP	ENABLED.		
				ANGLE		
				MIM. V.		
				TRIP		
				BLOCKING		

SETPOINTS (change)	TABLE 1 (change)	PROTECTION	SYNCHRO	SI.CH.EN		Enable synchronism general function
				SUBV.CO	!A and !B	Enable no voltage in A or B
					!A and B	Enable no voltage in A, but in B
					A and !B	Enable no voltage in B, but in A
				RECLOSER UV. CONDIT.	!A and !B	Enable no voltage in A nor in B
					!A and B	Enable no voltage in A, but there is in B
					A and !B	Enable no voltage in B, but there is in A
				SI.CH.EN		Enable voltage difference
				A.DIF.EN		Enable angle difference
				F.DIF.EN		Enable frequency difference
				V.DIF.PU		Pick up voltage difference
				A.DIF.PU		Pick up angle difference
				F.DIF.P		Pick up frequency difference
				MIN. V A		Minimum voltage in A
				MIN. V B		Minimum voltage in B
				VA ABSEN		Lack of voltage in A
				VB ABSEN		Lack of voltage in B
				CL.CON.T		Close conditions timing
				BLOCKING		
			LOW VOLTAGE	ENABLE		Enab. min. V function of synchronism
				S.A PICK		Pick up voltage side A
				S.B PICK		Pick up voltage side B
				FIX. TIME		Definite time
				BLOCKING		

SETPOINTS (change)	TABLE 1 (change)	BREAKER MONITOR	E.T.C.SV	Enable trip circuit surveillance
			E.C.C.SV	Enable close circuit surveillance
		OPERATION LOGIC	TRIP LAT	Trip latch
			OP.F.TIM	Open failure time
			CL.F.TIM	Close failure time
		RECL. FREQUENCY	ENABLED	Enable frequency recloser
			FREQ COND.	
			MIN FREQ	
			VOLT. COND	
			MIN. VOLTAGE	
			RECL TIME	
			SECU TIME	
			S.M.CL.T	
			ENAB. WAIT.T..	
			DDF. WAIT. T.	
			BLOCKING	
	TABLE 2 (change)	AS TABLE 1		
	TABLE 3 (change)	AS TABLE 1		
	TABLE 4 (change)	AS TABLE 1		

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Comfig of the 7 program leds (function and type)
		GENERAL.	LANGUAGE		Spanish/English
			VOL.RAT		Voltage transformatio ratio
			NOM. VOLT		Nominal voltage
			IN V	TYPE V	Volt input, voltage type (simples or compounds)
				MEAS.V	Voltage measurement
			FAULT MEASURE		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter KEYWORD ↑↓┘┘	FREQUEN.		50 / 60 Hz
			CAL.SET.		For exclusive use of INGETEAM Technology
			DELETE?		Resets the events, faults, oscillo queues.
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG.	RTS signal
			BACK	ADDRESS	UCL address for DNP communications
			(if DNP programmed)	MAST. AD	Master address for DNP communications
				BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BIT	STOP BIT for DNP communications
				FIX.RTS	YES/NO
				COMMS C	RTS and CTS control for DNP communications
				CTS W.T	CTS wait. time for DNP communications(csec.)
				POR.W.T	CARRIER wait. time for DNP communic.(csec)
				STAB. T	Stabilization time for DNP communic.(csec)
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).
				SYNC. T	Synchronixation time for DNP communications(csec.)
				ACK LINK	Link acknowledge for DNP c
				BYT.AP.N	Number of application messages bytes for DNP
				CHANG.T	Change sending time for DNP communications
				FROZ.T	Counter freezing time for DNP
				STAT.S.	Status sending for DNP communications
				MEAS.B.N	Measurement format for DNP communicat.
				COUN.B.N	Counter format for DNP communications
				N.R.MSG	Non requested messages sending for DNP
				PR.COLL	Collision prevision for DNP communications
				COL.F. T",	Def. colision time for DNP communic.(csec.)
				COL.V. T",	T. de colisión variable for DNP (csec.)
				RESEND T	T. de reenvío de msgs. no pedidos for DNP
				N.R.MAX	Num. máx. mensajes no pedidos for DNP
				"ESPECIAL	Sspecial for DNP communications
				FORMAT	UCL address for DNP communications
				POSTTR. T.	Posttransmission time
			BACK	ADDRESS	UCL address
			(if MODBUS programmed)	BAUD RATE	Baud rate
				PARITY	Parity
				T.AC.RTS	RTS activation waiting time
				T.CARRIE	Carrier waiting time
				T.DE.RTS	RTS deactivation waiting time
				FORMAT	Format for MODBUS
			BACK	ADDRESS	UCL address

			(if 103 programmed)	BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BITS	Number of STOP. BIT.
				RTS ACT.	RTS activation waiting time
				CARRIER	Carrier waiting time
				RTS DIS.	RTS deactivation waiting time
				DATA FOR	Compatible VDEW/Extended
SETPOINTS (change)	COUNTER SETTING	OPEN= 0?			Set opening counters to zero

APPENDIX III. KEYBOARD/ DISPLAY (BLOCK OF PO FAMILY)

In the following pages we enclose a table in which the details and available settings in units belonging to the PO family are indicated.

DATE/TIME (see)		Units date and time are visualized.
SEE ACTIVE TABLE		Present active table
DIG. INPU	INP. STAT	Status of inputs 1 and 2
	(1 and 2)	Status of inputs 1 and 2
	(3 and 4)	Status of inputs 3 and 4
	(5 and 6)	Status of inputs 5 and 6
	(7 and 8)	Status of inputs7 and 8
DIG. OUT	OUT.STAT.	
	(1 and 2)	Status of outputs 1 and 2
	(3 and 4)	Status of outputs 3 and4
	(5 and 6)	Status of outputs 5 and 6
	(7 and 8)	Status of outputs 7 and 8
	(9 and 10)	Status of outputs9 and10
	(11)	Status of output 11
MEASURES	See following pages	
STATIST. DATA	See following pages	
LAST FAULTS	See following pages	
SETPOINTS(read)	See following pages	
SETPOINTS (change)	See following pages	

MEASURES	SECONDARY MEASUR	Curr (A)	Current
		Volt	Voltage
	PRIMARY MEASURES	Curr (A)	Current
		Volt	Voltage
	POWER MEASUR.	ACTUAL P	Active power (secondary)
		IDLE POW	Reactive power (secondary)
		APP.POW.	Apparent power (secondary)
		LAG FACT	Power factor
	AUXIL. MEASURES.	Vsup 3, 3V	Supply internal measurement 3.3V
		Vbat3, 3V	Battery internal measurement 3.3V
		Extern V	Supply external measurement
		TEMP (ºC)	Unit temperature (ºC)
STATIS. DATA	OPEN No.		Number of total openings by the protection
LAST FAULTS	FAULT n	TYPE	Cause of the last fault
		FAU.PO	Active power when the fault occurred (Sec)
		FAULT Q.	Reactive power when the last fault occurred (Sec)
		START T	Fault start date and time.
		END T	Fault end date and time.
		LedReseT	Fault acknowledgement to switch off the Led.

SETPOINTS (see)	TABLE 1 (see)	PROTECTION	UNDERPOW.	ENABLED	Minimum power
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OVERPOW HI-SET	ENABLED	Maximum power (High)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OVERPOW LO-SET	ENABLED	Maximum power (Low)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			REVERSE POWER HI	ENABLED	Reverse power (High)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			REVERSE POWER LO	ENABLED	Reverse power (Low)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			APPARENT UNDERPOW	ENABLED	Minimum apparent power
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OV.AP.PO HI-SET	ENABLED	Max. apparent power (High)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OV.AP.PO LO-SET	ENABLED	Max. apparent power (Low)
				PICK UP	
				DEF. TIME	
				BLOCKING	
	SEE TABLE 1	BREAKER MONITOR	E.T.C.SV		En. trip circuit surveillance
			E.C.C.SV		En. close circuit surveillance
		OPERATION LOGIC	TRIP LAT		Trip latch
			OP.F.TIM		Open failure time
			CL.F.TIM		Close failure time
	TABLE 2 (see)	AS TABLE 1			
	TABLE 3 (see)	AS TABLE 1			
	TABLE 4 (see)	AS TABLE 1			

SETPOINTS (see)	TABLE 0 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL.	VOL.RAT		Voltage transformatio ratio
			TRF.RAT.		Current transformatio ratio
			NOM. VOLT		Nominal voltage
			LANGUAGE		Spanish/English
			FAULT.M.		Primary/Secondary
		SPECIAL	FREQUEN.		50 / 60 Hz
			FEEDING SUPERVI.		Enable feeding supervision
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS

		BACK	ADDRESS	Protection address.	
		(if Procome programmed)	BAUD RATE	Baud rate (bauds).	
			PARITY	Parity (par) yes or no.	
			STOP BIT	Number of STOP BITS	
			CTROL SIG.	RTS Signal	
		BACK	ADDRESS	UCL address for DNP communications	
		(if DNP programmed)	MAST. AD	Master address for DNP communications	
			BAUD RATE	Baud rate in DNP communications	
			PARITY	Parity in DNP communications	
			STOP BIT	STOP BIT for DNP communications	
			FIX.RTS	YES/NO	
			COMMS C	RTS and CTS control for DNP communications	
			CTS W.T	CTS waiting time for DNP communications(csec.)	
			POR.W.T	CARRIER waiting time for DNP communications(csec.)	
			STAB. T	Stabilization time for DNP communications(csec.)	
			ACK.W.T	Link acknowledge waiting time for DNP(csec.).	
			SYNC. T	Synchronixation time for DNP communications(csec.)	
			ACK LINK	Link acknowledge for DNP c	
			BYT.AP.N	Number of application messages bytes for DNP	
			CHANG.T	Change sending time for DNP communications	
			FROZ.T	Counter freezing time for DNP	
			STAT.S.	Status sending for DNP communications	
			MEAS.B.N	Measurement format for DNP communications	
			COUN.B.N	Counter format for DNP communications	
			N.R.MSG	Non requested messages sending for DNP	
			PR.COLL	Collision prevision for DNP communications	
			COL.F. T",	Definite collsision time for DNP communications(csec.)	
			COL.V. T",	T. de colisión variable for DNP (csec.)	
			RESEND T	T. de reenvío de msgs. no pedidos for DNP	
			N.R.MAX	Max number of non requested messages for DNP	
			"ESPECIAL	Sspecial for DNP communications	
			FORMAT	UCL address for DNP communications	
			POSTTR T.	Posttransmission Time	
		BACK	ADDRESS	UCL address	
		(if MODBUS programmed)	BAUD RATE	Baud rate	
			PARITY	Parity	
			T.AC.RTS	RTS activation waiting time	
			T.CARRIE	Carrier waiting time	
			T.DE.RTS	RTS deactivation waiting time	
			FORMAT	Format for MODBUS	
		BACK	ADDRESS	UCL address	
		(if 103 programmed)	BAUD RATE	Baud rate in DNP communications	
			PARITY	Parity in DNP communications	
			STOP BITS	Number of STOP. BIT.	
			RTS ACT.	RTS activation waiting time	
			CARRIER	Carrier waiting time	
			RTS DIS.	RTS deactivation waiting time	
			DATA FOR	Compatible VDEW/Extended	
		TCP/IP	SEE COM TCPIP	TCPIP P.	See TCP/IP communications (NO, PROCOME)
			SEE PAR TCPIP	PROCOME PARAM.	ADDRESS

SETPOINTS (change)	DATE/TIME (change)				
ENTER KEYWORD	ACTIVATE TABLE	TABLE1 ?			Make table 1 active.
↑↑↓↓		TABLE 2 ?			Make table 2 active..
		TABLE 3?			Make table 3 active.
		TABLE 4?			Make table 4 active.
SETPOINTS (change)	TABLE 1 (change)	PROTECTION	UNDERPOW.	ENABLED	Minimum power
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OVERPOW HI-SET	ENABLED	Maximum power (High)
				PICK UP	

SETPOINTS (change)	TABLE 1 (change)	BREAKER MONITOR	E.T.C.SV		Trip circuit monitoring enable.
			E.C.C.SV		Close circuit monitoring enable.
		OPERATION LOGIC	TRIP LAT		Trip locking.
			OP.F.TIM		Open failure timing.
			CL.F.TIM		Close failure timing.
	TABLE 2 (change)	AS TABLE 1			
	TABLE 3(change)	AS TABLE 1			
	TABLE 4 (change)	AS TABLE 1			
				DEF. TIME	
				BLOCKING	
			OVERPOW LO-SET	ENABLED	Maximum power (Low)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			REVERSE POWER HI	ENABLED	Reverse power (High)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			REVERSE POWER LO	ENABLED	Reverse power (Low)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			APPARENT UNDERPOW	ENABLED	Minimum apparent power
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OV.AP.PO HI-SET	ENABLED	Maximum apparent power (High)
				PICK UP	
				DEF. TIME	
				BLOCKING	
			OV.AP.PO LO-SET	ENABLED	Maximum apparent power (Low)
				PICK UP	
				DEF. TIME	
				BLOCKING	

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Conf. of the 7 program. leds (function and type)
		GENERAL.	VOL.RAT		Voltage transformatio ratio
			TRANSFORM. RATIO	TRF.RAT.	Current transfomatio ratio
			NOM. VOLT		Nominal voltage
			LANGUAGE		Spanish/English
			FAULT MEASURE		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter KEYWORD ↑↓.⊥⊥	FREQUEN.		50 / 60 Hz
			CAL.SET		For exclusive use of INGETEAM Technology SA
			DELETE?		Resets the events, faults, oscillo queues.
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG.	RTS signal
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).

				PARITY	Parity (par) yes or no.	
				STOP BIT	Number of STOP BITS	
			BACK	ADDRESS	UCL address for DNP communications	
			(if DNP programmed)	MAST. AD	Master address for DNP communications	
				BAUD RATE	Baud rate in DNP communications	
				PARITY	Parity in DNP communications	
				STOP BIT	STOP BIT for DNP communications	
				FIX.RTS	YES/NO	
				COMMS C	RTS and CTS control for DNP communications	
				CTS W.T	CTS waiting time for DNP communications(csec.)	
				POR.W.T	CARRIER waiting time for DNP communications(csec.)	
				STAB. T	Stabilization time for DNP communications(csec.)	
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).	
				SYNC. T	Synchronixation time for DNP communications(csec.)	
				ACK LINK	Link acknowledge for DNP c	
				BYT.AP.N	Number of application messages bytes for DNP	
				CHANG.T	Change sending time for DNP communications	
				FROZ.T	Counter freezing time for DNP	
				STAT.S.	Status sending for DNP communications	
				MEAS.B.N	Measurement format for DNP communications	
				COUN.B.N	Counter format for DNP communications	
				N.R.MSG	Non requested messages sending for DNP	
				PR.COLL	Collision prevision for DNP communications	
				COL.F. T",	Def.collision time for DNP communications(csec.)	
				COL.V. T",	T. de colisión variable for DNP (csec.)	
				RESEND T	T. de reenvío de msgs. no pedidos for DNP	
				N.R.MAX	Num. máx. mensajes no pedidos for DNP	
				ESPECIAL	Sspecial for DNP communications	
				FORMAT	UCL address for DNP communications	
				POSTTR T.	Posttransmission Time	
			BACK	ADDRESS	UCL address	
			(if MODBUS programmed)	BAUD RATE	Baud rate	
				PARITY	Parity	
				T.AC.RTS	RTS activation waiting time	
				T.CARRIE	Carrier waiting time	
				T.DE.RTS	RTS deactivation waiting time	
				FORMAT	Format for MODBUS	
			BACK	ADDRESS	UCL address	
			(if 103 programmed)	BAUD RATE	Baud rate in DNP communications	
				PARITY	Parity in DNP communications	
				STOP BITS	Number of STOP. BIT.	
				RTS ACT.	RTS activation waiting time	
				CARRIER	Carrier waiting time	
				RTS DIS.	RTS deactivation waiting time	
				DATA FOR	Compatible VDEW/Extended	
			TCP/IP	TCPIP COM SELEC	TCPIP P.	Select TCP/IP communications (NO, PROCOME)
				PG.TCPIP PARAM	PROCOME PARAM.	ADDRESS
SETPOINTS (change)	COUNTER SETTING	OPEN=0?			Set opening counters to zero	

APPENDIX IV. KEYBOARD / DISPLAY (BLOCK OF PC FAMILY)

In the following pages we enclose a table in which the details and available settings in units belonging to the PC family are indicated.

DATE/TIME (see)		Units date and time are visualized.
SEE ACTIVE TABLE		Present active table
DIG. INPU	INP. STAT	Status of inputs 1 and 2
	(1 and 2)	Status of inputs 1 and 2
	(3 and 4)	Status of inputs 3 and 4
	(5 and 6)	Status of inputs 5 and 6
	(7 and 8)	Status of inputs7 and 8
DIG. OUT	OUT.STAT.	
	(1 and 2)	Status of outputs 1 and 2
	(3 and 4)	Status of outputs 3 and4
	(5 and 6)	Status of outputs 5 and 6
	(7 and 8)	Status of outputs 7 and 8
	(9 and 10)	Status of outputs9 and10
	(11)	Status of output11
MEASURES	See following pages	
STATIST. DATA	See following pages	
LAST FAULTS	See following pages	
SETPOINTS (read)	See following pages	
SETPOINTS (change)	See following pages	

MEASURES	SECONDARY MEASUR	Curr (A)	Current
		Vol VA	Phase A voltage.
		Vol VB	Phase B voltage
		Vol VC	Phase C voltage
		Mean. Vol	Mean voltage
		Rel. VAB	Compound voltage AB
		Rel. VBC (V)	Compound voltage BC
		Rel. VCA	Compound voltage CA
		Vcomp(V)	Mean compound voltage
	MED. PRIMARIO	Inten (A)	Current
		VA (kV)	Phase A voltage in the primary
		VB (kV)	Phase B voltage in the primary
		VC (kV)	Phase C voltage in the primary
		VAB (kV)	Compound voltage AB in the primary
		VBC (kV)	Compound voltage BC in the primary
		VCA (kV)	Compound voltage CA in the primary
		Vcom(kV)	Average compound voltage in the primary
	IMPEDANC. MEASURES	Z real	Real value of the calculated impedance
		Z imag	Imaginary value of the calculated impedance
	AUXILIAR	Vsup 3, 3V	Supply internal measurement 3.3V
		Vbat3, 3V	Battery internal measurement 3.3V
		Extern V	Supply external measurement
		TEMP (ºC)	Unit temperature (ºC)
STATIS. DATA	OPEN No.		Total number of trips given by the protection
LAST FAULTS	FAULT n	TYPE	Phase/s in which the last fault has occurred
		Faul.V.A	Voltage in phase A when the fault occurred (Sec).
		Faul.V.B	Voltage in phase B when the fault occurred (Sec).
		Faul.VB	Voltage in phase C when the fault occurred (Sec).
		Faul.V.N	Voltage in the ground when the fault occurred (Sec).
		Hz FAULT	Frequency when the fault occurred (Hz).
		START T	Fault start date and time.
		END T	Fault end date and time.
		LEDreset	Fault leds reset.

SETPOINTS (see)	TABLE 1 (see)	PROTECT	LOSS OF FIELD	GENERAL.	ENABLED	Enabled
					MIN.VOL.	Minimum voltage
					DIR.ANG.	Directional angle
					C PHASE	Phase in which current is measured
					NOM.VOL.	Nominal voltage
					BLOCKING	Blockings
				ZONE 1	OFFSET	Offset zone 1
					DIAMETER	Diameter zone 1
					SUBV VIG	Undervoltage surveillance zone 1
					ALARM T	Time alarm zone 1
					TRIP T.	Time trip zone 1
				ZONE 2	OFFSET	Offset zone 2
					DIAMETER	Diameter zone 2
					SUBV VIG	Undervoltage surveillance zone 2
					ALARM T	Time alarm zone 2
					TRIP T.	Time trip zone 2
		SUPERVI. BREAKER	E.T.C.SV			Enable trip circuit supervision
			E.C.C.SV			Enable close circuit supervision
		OPERATION LOGIC	TRIP LAT			Trip latch
			OP.F.TIM			Opening failure time.
			CL.F.TIM			Losing failure time
	TABLE 2 (see)	AS TABLE 1				
	TABLE 3 (see)	AS TABLE 1				
	TABLE 4 (see)	AS TABLE 1				

SETPOINTS (see)	TABLE 0 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL.	PH.RATIO		Phase transformatio ratio
			VOL.RAT		Voltage transformatio ratio
			LANGUAGE		Spanish/English
			FAULT.M.		Primary/Secondary
		SPECIAL	FREQUEN.		50 / 60 Hz
			FEEDING SUPERVI.		Enable feeding supervision
		CONFIG.COMMUNIC..	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			BACK	ADDRESS	UCL address for DNP communications
			(if DNP programmed)	MAST. AD	Master address for DNP communications
				BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BIT	STOP BIT for DNP communications
				FIX.RTS	YES/NO
				COMMS C	RTS and CTS control for DNP communications
				CTS W.T	CTS waiting time for DNP communications(csec.)
				POR.W.T	CARRIER waiting time for DNP communications(csec.)
				STAB. T	Stabilization time for DNP communications(csec.)
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).
				SYNC. T	Synchronixation time for DNP communications(csec.)
				ACK LINK	Link acknowledge for DNP c
				BYT.AP.N	Number of application messages bytes for DNP
				CHANG.T	Change sending time for DNP communications
				FROZ.T	Counter freezing time for DNP
				STAT.S.	Status sending for DNP communications
				MEAS.B.N	Measurement format for DNP communications
				COUN.B.N	Counter format for DNP communications
				N.R.MSG	Non requested messages sending for DNP
				PR.COLL	Collision prevision for DNP communications
				COL.F. T",	Definite collsision time for DNP communications(csec.)
				COL.V. T",	T. de colisión variable for DNP (csec.)
				RESEND T	T. de reenvío de msgs. no pedidos for DNP
				N.R.MAX	Num. máx. mensajes no pedidos for DNP
				*ESPECIAL	Sspecial for DNP communications
				FORMAT	UCL address for DNP communications
				POSTTR T.	Posttransmission time
			BACK	ADDRESS	UCL address
			(if MODBUS programmed)	BAUD RATE	Baud rate
				PARITY	Parity
				T.AC.RTS	RTS activation waiting time
				T.CARRIE	Carrier waiting time
				T.DE.RTS	RTS deactivation waiting time
				FORMAT	Format for MODBUS
			BACK	ADDRESS	UCL address
			(if 103 programmed)	BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BITS	Number of STOP. BIT.
				RTS ACT.	RTS activation waiting time

				CARRIER	Carrier waiting time		
				RTS DIS.	RTS deactivation waiting time		
				DATA FOR	Compatible VDEW/Extended		
			TCP/IP	SEE COM TCPIP	TCPIP P.		See TCP/IP communications (NO, PROCOME)
				SEE PAR TCPIP	PROCOME PARAM.		ADDRESS

SETPOINTS (change)	DATE/TIME (change)					
ENTER KEYWORD	ACTIVATE TABLE	TABLA 1 ?				Hacer activa la tabla 1.
↑↑↓↓		TABLA 2 ?				Hacer activa la tabla 2.
		TABLA 3?				Hacer activa la tabla 3.
		TABLA 4?				Hacer activa la tabla 4.
SETPOINTS (change)	TABLE 1 (change)	PROTECT	LOSS OF FIELD	GENERAL.	ENABLED	Enabled
					MIN.VOL.	Minimum voltage
					DIR.ANG.	Directional angle
					C PHASE	Phase in which current is measured
					NOM.VOL.	Nominal voltage
					BLOCKING	Blockings
				ZONE 1	OFFSET	Offset zone 1
					DIAMETER	Diameter zone 1
					SUBV VIG	Undervoltage surveillance zone 1
					ALARM T	Time alarm zone 1
					TRIP T.	Time trip zone 1
				ZONE 2	OFFSET	Offset zone 2
					DIAMETER	Diameter zone 2
					SUBV VIG	Undervoltage surveillance zone 2
					ALARM T	Time alarm zone 2
					TRIP T.	Time trip zone 2
		SUPERVI. BREAKER	E.T.C.SV			Enable trip circuit supervision
			E.C.C.SV			Enable close circuit supervision
		OPERATION LOGIC	TRIP LAT			Trip latch
			OP.F.TIM			Opening failure time.
			CL.F.TIM			Losing failure time
	TABLE 2 (change)	AS TABLE 1				
	TABLE 3 (change)	AS TABLE 1				
	TABLE 4 (change)	AS TABLE 1				

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL	PHAS.RAT		Phase transformatio ratio
			VOL.RAT		Voltage transformatio ratio
			LANGUAGE		Spanish/English
			FAULT MEASURE		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter KEYWORD ↑↓⌟⌟	FREQUEN.		50 / 60 Hz
			CAL SET		Para uso exclusivo de INGETEAM Technology
			DELETE?		Resetea las colas de sucesos, faltas, oscilos...
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			BACK	ADDRESS	UCL address for DNP communications

			(if DNP programmed)	MAST. AD	Master address for DNP communications	
				BAUD RATE	Baud rate in DNP communications	
				PARITY	Parity in DNP communications	
				STOP BIT	STOP BIT for DNP communications	
				FIX.RTS	YES/NO	
				COMMS C	RTS and CTS control for DNP communications	
				CTS W.T	CTS waiting time for DNP communications(csec.)	
				POR.W.T	CARRIER waiting time for DNP communications(csec.)	
				STAB. T	Stabilization time for DNP communications(csec.)	
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).	
				SYNC. T	Synchronixation time for DNP communications(csec.)	
				ACK LINK	Link acknowledge for DNP c	
				BYT.AP.N	Number of application messages bytes for DNP	
				CHANG.T	Change sending time for DNP communications	
				FROZ.T	Counter freezing time for DNP	
				STAT.S.	Status sending for DNP communications	
				MEAS.B.N	Measurement format for DNP communications	
				COUN.B.N	Counter format for DNP communications	
				N.R.MSG	Non requested messages sending for DNP	
				PR.COLL	Collision prevision for DNP communications	
				COL.F. T",	Definite collsision time for DNP communications(csec.)	
				COL.V. T",	T. de colisión variable for DNP (csec.)	
				RESEND T	T. de reenvío de msgs. no pedidos for DNP	
				N.R.MAX	Num. máx. mensajes no pedidos for DNP	
				"ESPECIAL	Sspecial for DNP communications	
				FORMAT	UCL address for DNP communications	
				POSTTR T.	Posttransmission time	
			BACK	ADDRESS	UCL address	
			(if MODBUS programmed)	BAUD RATE	Baud rate	
				PARITY	Parity	
				T.AC.RTS	RTS activation waiting time	
				T.CARRIE	Carrier waiting time	
				T.DE.RTS	RTS deactivation waiting time	
				FORMAT	Format for MODBUS	
			BACK	ADDRESS	UCL address	
			(if 103 programmed)	BAUD RATE	Baud rate in DNP communications	
				PARITY	Parity in DNP communications	
				STOP BITS	Number of STOP. BIT.	
				RTS ACT.	RTS activation waiting time	
				CARRIER	Carrier waiting time	
				RTS DIS.	RTS deactivation waiting time	
				DATA FOR	Compatible VDEW/Extended	
			TCP/IP	TCPIP COM SELEC	TCPIP P.	Select TCP/IP communications (NO, PROCOME)
				PG.TCPIP PARAM	PROCOME PARAM.	ADDRESS
SETPOINTS (change)	COUNTER SETTING	OPEN=0?			Set opening counters to zero	

APPENDIX V. KEYBOARD/ DISPLAY (BLOCK OF NT FAMILY)

In the following pages we enclose a table in which the details and available settings in units belonging to the NT family are indicated.

DATE/TIME (see)		Units date and time are visualized.
SEE ACTIVE TABLE		Present active table
DIG. INPU	INP. STAT	Status of inputs 1 and 2
	(1 and 2)	Status of inputs 1 and 2
	(3 and 4)	Status of inputs 3 and 4
	(5 and 6)	Status of inputs 5 and 6
	(7 and 8)	Status of inputs7 and 8
DIG. OUT	OUT.STAT.	Status of outputs 1 and 2
	(3 and 4)	Status of outputs 3 and4
	(5 and 6)	Status of outputs 5 and 6
	(7 and 8)	Status of outputs 7 and 8
	(9 and 10)	Status of outputs9 and10
	(11)	Status of output11
MEASURES	See following pages	
STATIST. DATA	See following pages	
LAST FAULTS	See following pages	
SETPOINTS (read)	See following pages	
SETPOINTS (change)	See following pages	

MEASURES	SECONDARY MEASUR	GND. (A)	Current ground
		N 2 C (A)	Current ground 2
		N 3 C (A)	Current ground 3
		V (V)	Voltage
	PRIMARY MEASURES	GND (A)	Current ground in the primary
		N 2 C (A)	Current ground 2 in the primary
		N 3 C (A)	Current ground 3 in the primary
		V (kV)	Voltage in the primary
	FREq(Hz)		Frequency
	AUXIL. MEASURES	Vsup 3, 3V	Supply internal measurement 3.3V
		Vbat3, 3V	Battery internal measurement 3.3V
		Extern V	Supply external measurement
		TEMP (ºC)	Unit temperature (ºC)
STATIS. DATA	OPEN No.		Total number of trips given by the protection
LAST FAULTS	FAULT n	TYPE	Phase/s in which the last fault has occurred
		Faul.GND	Current in the neutral when the fault occurred (Sec)
		Faul.GND 2	Current in the neutral 2 when the fault occurred (Sec)
		Faul.GND 3	Current in the neutral 3 when the fault occurred (Sec)
		Hz FAULT	Frequency(Hz) when the fault occurred
		START T	Fault start date and time.
		END T	Fault end date and time.
		LedReseT	Fault acknowledgement to switch off the Led.

SETPOINTS (see)	TABLE 1 (see)	PROTECT	GROUND TOC MAX.HI POTENCIA MAX.LO POTENCIA INV.HI POTENCIA	ENABLED
				PICK UP
				CURVES
				INDEX
				DEFINITE TIME
				BLOCKING
			GROUND IOC	ENABLED
				PICK UP
				DEFINITE TIME
				BLOCKING
			GROUND TOC 1	ENABLED
				PICK UP
				CURVES
				INDEX
				DEFINITE TIME
				BLOCKING
			GROUND TOC 2	ENABLED
				PICK UP
				CURVES
				INDEX
				DEFINITE TIME
				BLOCKING
			GROUND IOC 1	ENABLED
				PICK UP
				DEFINITE TIME
				BLOCKING
			GROUND IOC 2	ENABLED
				PICK UP
				DEFINITE TIME
				BLOCKING
			BREAKER FAILURE	ENABLED
				GND DROP
				DEFINITE TIME
				BLOCKING

SETPOINTS (see)	TABLE 1 (see)	PROTECT	RESTRIN. GND	ENABLED	Enabled restricted ground
				PICK UP	Pick up
				DEF. TIME	Definite time
				BLOCKING	Bloking conditions
			OVER.T	ENABLED	Enable overexcitation timing
				MIN V	Overexcitation minimum voltage
				PICK UP	Pick up
				CURVES	Curves
				INDEX	Index
				DEF. TIME	Additional time
				RST.TIME	Restoration time
				BLOCKING	Locking
			OVER.I	ENABLED	Enable overexcitation instantaneous
				MIN V	Overexcitation minimum voltage
				PICK UP	Pick up
				DEF. TIME	Additional time
				RST.TIME	Restoration time
				BLOCKING	Locking
		SUPERVI. BREAKER	E.T.C.SV		Trip circuit monitoring enable.
			E.C.C.SV		Close circuit monitoring enable.
		OPERATION LOGIC	TRIP LATCH		Trip locking.
			OPEN FAIL T		Open failure timing.
			CLOS FAIL T		Close failure timing.
	TABLE 2 (change)	AS TABLE 1			
	TABLE 3 (change)	AS TABLE 1			
	TABLE 4 (change)	AS TABLE 1			

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERALS	GNDRATIO		Ground current transformatio ratio
			PHAS.RAT		Phase transformatio ratio
			VOL.RAT		Voltage transformatio ratio
			LANGUAGE		Spanish/English
			FAULT.M.		Primary/Secondary
		SPECIAL	FREQUEN.		50 / 60 Hz
			FEEDING SUPERV		Enable
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	UCL address for DNP communications
				CTROL SIG	RTS signal
			(if DNP programmed)	MAST. AD	Master address for DNP communications
				BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BIT	STOP BIT for DNP communications
				FIX.RTS	YES/NO
				COMMS C	RTS and CTS control for DNP communications
				CTS W.T	CTS waiting time for DNP communications(csec.)
				POR.W.T	CARRIER waiting time for DNP communications(csec.)
				STAB. T	Stabilization time for DNP communications(csec.)
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).
				SYNC. T	Synchronixation time for DNP communications(csec.)

			ACK LINK	Link acknowledge for DNP c
			BYT.AP.N	Number of application messages bytes for DNP
			CHANG.T	Change sending time for DNP communications
			FROZ.T	Counter freezing time for DNP
			STAT.S.	Status sending for DNP communications
			MEAS.B.N	Measurement format for DNP communications
			COUN.B.N	Counter format for DNP communications
			N.R.MSG	Non requested messages sending for DNP
			PR.COLL	Collision prevision for DNP communications
			COL.F. T*,	Definite collsision time for DNP communications(csec.)
			COL.V. T*,	T. de colisión variable for DNP (csec.)
			RESEND T	T. de reenvío de msgs. no pedidos for DNP
			N.R.MAX	Num. máx. mensajes no pedidos for DNP
			*ESPECIAL	Sspecial for DNP communications
			FORMAT	UCL address for DNP communications
			POSTTR T.	Posttransmission time
		BACK	ADDRESS	UCL address
		(if MODBUS programmed)	BAUD RATE	Baud rate
			PARITY	Parity
			T.AC.RTS	RTS activation waiting time
			T.CARRIE	Carrier waiting time
			T.DE.RTS	RTS deactivation waiting time
			FORMAT	Format for MODBUS
		BACK	ADDRESS	UCL address
		(if 103 programmed)	BAUD RATE	Baud rate in DNP communications
			PARITY	Parity in DNP communications
			STOP BITS	Number of STOP. BIT.
			RTS ACT.	RTS activation waiting time
			CARRIER	Carrier waiting time
			RTS DIS.	RTS deactivation waiting time
			DATA FOR	Compatible VDEW/Extended

SETPOINTS (change)	DATE/TIME (change)				
ENTER KEYWORD	ACTIVATE TABLE	TABLE1 ?			Make table 1 active.
↑↑↓↓		TABLE 2 ?			Make table 2 active..
		TABLE 3?			Make table 3 active.
		TABLE 4?			Make table 4 active.
SETPOINTS (change)	TABLE 1 (change)	PROTECTION	GROUND TOC MAX.HI POTENCIA MAX.LO POTENCIA INV.HI POTENCIA	ENABLED	
				PICK UP	
				CURVES	
				INDEX	
				DEFINTE TIME	
				BLOCKING	
			GROUND IOC	ENABLED	
				PICK UP	
				DEFINTE TIME	
				BLOCKING	
			GROUND TOC1	ENABLED	
				PICK UP	
				CURVES	
				INDEX	
				DEFINTE TIME	
				BLOCKING	
			GROUND TOC 2	ENABLED	
				PICK UP	
				CURVES	
				INDEX	
				DEFINTE TIME	
				BLOCKING	
			GROUND IOC 1	ENABLED	
				PICK UP	

				DEFINTE TIME	
				BLOCKING	
			GROUND IOC 2	ENABLED	
				PICK UP	
				DEFINTE TIME	
				BLOCKING	

SETPOINTS (change)	TABLE 1 (change)	PROTECTION	BREAKER FAILURE	ENABLED	
				GND DROP	
				DEFINITE TIME	
				BLOCKING	
			RESTRIN. GND	ENABLED	Enable
				PICK UP	Pickup
				DEF. TIME	Fixed time
				BLOCKING	Locking condition
			OVER.T	ENABLED	Enable overexcitation timing
				MIN V	Overexcitation minimum voltage
				PICK UP	Pick up
				CURVES	Curves
				INDEX	Index
				DEF. TIME	Additional timing
				RST.TIME	Restoration timing
				BLOCKING	Locking
			OVER.I	ENABLED	Enable overexcitation instantaneous
				MIN V	Overexcitation minimum voltage
				PICK UP	Pick up
				DEF. TIME	Additional timing
				RST.TIME	Restoration timing
				BLOCKING	Locking
		SUPERVI. BREAKER	E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OPERATION LOGIC	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (change)	AS TABLE 1			
	TABLE 3 (change)	AS TABLE 1			
	TABLE 4 (change)	AS TABLE 1			

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configurat. of the 7 programmable leds (function and type)
		GENERAL	GND RATIO		Neutral current transformation ratio
			G1 RATIO		Transformatio ratio of the G1 current
			G2 RATIO		Transformatio ratio of the G2 current
			VOLT. RAT.		Voltage transformation ratio
			NOMINALVOLTAGE		Nominal voltage
			LANGUAGE		Spanish/English
			FAULT MEASURE		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter KEYWORD ↑↓.┘	FREQUEN.		50 / 60 Hz
			CAL SET		For exclusive use of INGETEAM Technology SA
			DELETE?		Resets the event, fault, osillograph queues
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			BACK	ADDRESS	UCL address for DNP communications
			(if DNP programmed)	MAST. AD	Master address for DNP communications
				BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BIT	STOP BIT for DNP communications
				FIX.RTS	YES/NO
				COMMS C	RTS and CTS control for DNP communications
				CTS W.T	CTS waiting time for DNP communications(csec.)
				POR.W.T	CARRIER waiting time for DNP communications(csec.)
				STAB. T	Stabilization time for DNP communications(csec.)
				ACK.W.T	Link acknowledge waiting time for DNP(csec.).
				SYNC. T	Synchronixation time for DNP communications(csec.)
				ACK LINK	Link acknowledge for DNP c
				BYT.AP.N	Number of application messages bytes for DNP
				CHANG.T	Change sending time for DNP communications
				FROZ.T	Counter freezing time for DNP
				STAT.S.	Status sending for DNP communications
				MEAS.B.N	Measurement format for DNP communications
				COUN.B.N	Counter format for DNP communications
				N.R.MSG	Non requested messages sending for DNP
				PR.COLL	Collision prevision for DNP communications
				COL.F. T	Definite collsision time for DNP communications(csec.)
				COL.V. T	T. de colisión variable for DNP (csec.)
				RESEND T	T. de reenvío de msgs. no pedidos for DNP
				N.R.MAX	Num. máx. mensajes no pedidos for DNP
				"ESPECIAL	Sspecial for DNP communications
				FORMAT	UCL address for DNP communications
				POSTTR T.	Posttransmission time
			BACK	ADDRESS	UCL address
			(if MODBUS programmed)	BAUD RATE	Baud rate
				PARITY	Parity
				T.AC.RTS	RTS activation waiting time
				T.CARRIE	Carrier waiting time
				T.DE.RTS	RTS deactivation waiting time
				FORMAT	Format for MODBUS

			BACK	ADDRESS	UCL address
			(if 103 programmed)	BAUD RATE	Baud rate in DNP communications
				PARITY	Parity in DNP communications
				STOP BITS	Number of STOP. BIT.
				RTS ACT.	RTS activation waiting time
				CARRIER	Carrier waiting time
				RTS DIS.	RTS deactivation waiting time
				DATA FOR	Compatible VDEW/Extended
SETPOINTS (change)	COUNTER SETTING	OPEN=0?			Set opening counters to zero

APPENDIX VI. KEYBOARD / DISPLAY (BLOCK OF SC AND CT FAMILIES)

In the following pages we enclose a table in which the details and available settings in units belonging to the SC and CT family are indicated.

DATE/TIME (see)		Units date and time are visualized.
SEE ACTIVE TABLE		Present active table
DIG. INPU	INP. STAT	Status of inputs 1 and 2
	(1 and 2)	Status of inputs 1 and 2
	(3 and 4)	Status of inputs 3 and 4
	(5 and 6)	Status of inputs 5 and 6
	(7 and 8)	Status of inputs7 and 8
DIG. OUT	OUT.STAT.	Status of outputs 1 and 2
	(3 and 4)	Status of outputs 3 and4
	(5 and 6)	Status of outputs 5 and 6
	(7 and 8)	Status of outputs 7 and 8
	(9 and 10)	Status of outputs9 and10
	(11)	Status of output 11
MEASURES	See following pages	
STATIST. DATA	See following pages	
LAST FAULTS	See following pages	
SETPOINTS(read)	See following pages	
SETPOINTS (change)	See following pages	

MEASURES	SECONDARY MEASUR	PhaseA (A)	Current in phase A.
		Phase C (A)	Current in phase fase C.
		Phase (A)	Current in ground
		V (V)	Voltage
	PRIMARY MEASURES	Phase A (A)	Current in phase A in the primary
		Phase C (A)	Current in phase fase C in the primary
		Gnd. (A)	Current in ground in the primary
		V (kV)	Tensión en el primario
	AUXIL. MEASURES.	Vsup 3, 3V	Supply internal measurement 3.3V
		Vbat3, 3V	Battery internal measurement 3.3V
		Extern V	Supply external measurement
		TEMP (ºC)	Unit temperature (ºC)
STATIS. DATA	OPEN No.		Number of total openings by the protection

SETPOINTS (see)	TABLE 1 (see)	SUPERVI. BREAKER	E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OCR	PHASE DF T.U.	ENABLED	Enable time phase fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			GND DF T.U.	ENABLED	Enable time neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			S.GND DF T.U.	ENABLED	Enable time sensitive neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			PHASE DF INST	ENABLED	Enable instantaneous phase fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			GND DF INST	ENABLED	Enable instantaneous neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			S.GND DF INST	ENABLED	Enable instantaneous sensitive neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			DF GENERAL	Vvp LEV.	Voltage presence level
				FAU.M.T.	Fault memory time
				V.TIME	Restoration voltage presence minimum time
				L.TIME	Light signal restoration time
				Vva LEV.	Voltage ausence level
				THRESH %	Voltage presence/ausence threshold (%)
				R.T.R.S.	Restore Time of Remote control Signal (sec)
			EXTING.CURRENT	PHS.CUR.	Phases extinguish current
				NEUT.CUR	Neutral extinguish current
				SNEU.CUR	Sensitive neutral extinguish current
			RESTRAIN HARM.2	PHS.ENAB	Phases enable
				GND.ENAB	Neutral enable
				THRESH %	I2f/If threshold (%)
				P.MIN.C.	Phase minimum current
				G.MIN.C.	Neutral minimum current
			DF AUTOMAT	RECL.N.	Recloser number
				T1 TIME	Time T1 (sec.)
				T2 TIME	Time T2 (sec.)
				T3 TIME	Time T3 (sec.)
		OPERATION LOGIC	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (see)	AS TABLE 1			
	TABLE 3 (see)	AS TABLE 1			
	TABLE 4 (see)	AS TABLE 1			
SETPOINTS (see)	TABLE 0 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL	PH. RATIO		Phase current transformation ratio
			GND RATIO		Neutral current transformation ratio
			VOL. RAT		Voltage transformation ratio
			NOMINALVOLTAGE		Nominal voltage
			TIME UNKNOWN 52	TIME UNKNOWN 52	Timing of the unknown state 52
			SLACK SPRINGS		Spring slacks

		LANGUAGE		Spanish/English
		PHS.CUR.		Programmable phase current measurements scale limit
		NEUT.CUR		Programmable neutral current measurements scale limit
	SPECIAL	PH ORDER		A-B-C / C-B-A
		FREQUEN.		50 / 60 Hz
		EN.BUTT.		Enable pushbuttons
		FEEDING SUPERVI		Enable feeding supervision
	CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
		FRONT	ADDRESS	Protection address
			BAUD RATE	Baud rate (bauds).
			PARITY	Parity (par) yes or no.
			STOP BIT	Number of STOP BITS
		BACK	ADDRESS	Protection address.
		(if Procome programmed)	BAUD RATE	Baud rate (bauds).
			PARITY	Parity (par) yes or no.
			STOP BIT	Number of STOP BITS
			CTROL SIG	RTS signal
		BACK	ADDRESS	UCL address for Gestel communications
		(if Gestel)	BAUD RATE	Baud rate in Gestel communications
			PARITY	Parity Gestel communications
			CTS	(Hund. Sec.)
			Chan.Typ	Channel type (Normal or RTC/GSM)
			AC.POR.T	Carrier activation time (hund.sec)
			DELTA 1	(Hund. Sec.)
			DELTA 4	(Hund. Sec.)
			Dir.log.	Remote station logical direction

		P.Sincr.	Synchronsm permission
	PORT COM2	LCU ADDRESS	LCU address for DNP communications
	(If DNP)	MASTER ADDRESS	Master address for DNP communications
		BAUD RATE	Baud rate for DNP communications
		TYPE OF PARITY	Parity for DNP communications
		STOP ITS	Stop bits for DNP communications
		FIXED RTS	YES/NO
		RTS AND CTS CTRL	RTS and CTS control for DNP communications
		CTS. WAIT. TIME(csec)	CTS waiting time for DNP communications
		CARR. WAIT. TIM.(csec)	CARRIER waiting time for DNP communications
		STABIL TIME . (csec)	Stabilization time for DNP communications
		ACK. WAIT. TIME(csec)	Link acknowledge waiting time for DNP
		SYNCHRO. TIME. (min)	Synchronization time for DNP communications
		LINK ACK.	Link acknowledge for DNP communications
		AP. MESS BYTE N.	N. bytes of application messages for DNP
		T.CHANGES	Changes sending time for DNP communications
		T.FROZEN	Counter freezing time for DNP
		STATUS SEND	Status sending for DNP communications
		MEAS. BITS NUM.	Measurements format for DNP communications
		COUNT. BITS NUM.	Counter format for DNP communications
		NON REQUEST. MESS.	Non requested message sending for DNP
		PREV.CONFLICT	Conflict prev. for DNP communications
		FIXED COL. TIME (csec)	Fixed conflict time for DNP communications
		VBLE. COL. TIME (csec)	Variable conflict time for DNP
		T.RESEND	Non requested messages resend time for DNP
		N.MAX.NO REQUEST.	Max. non requested messages number for DNP
		SPECIAL	Special for DNP communications
		MEASURES FORMAT	Counts/value in the secondary/value inl the primary
		T.POSTTR	Posttransmssion time

BACK	ADDRESS	UCL address for Gestel communications
(if PID1)	BAUD RATE	Baud rate in Gestel communications
	PARITY	Parity Gestel communications
	CTS	(Hund. Sec.)
	Chan.Typ	Channel type (Normal or RTC/GSM)
	AC.POR.T	Carrier activation time (hund.sec)
	DELTA 1	(Hund. Sec.)
	DELTA 4	(Hund. Sec.)
	T.ac.Sil	Line silence activation time (sec.)
	P.G.Cam.	Change general request
	D.Sen.F.	Reliability signal address
	T.c.Sen.	Reliability signalchange time
	P.Sincr.	Synchronsm permission
PORT COM2	LCU ADDRESS	LCU address for DNP communications
(If DNP)	MASTER ADDRESS	Master address for DNP communications
	BAUD RATE	Baud rate for DNP communications
	TYPE OF PARITY	Parity for DNP communications
	STOP ITS	Stop bits for DNP communications
	FIXED RTS	YES/NO
	RTS AND CTS CTRL	RTS and CTS control for DNP communications
	CTS. WAIT. TIME(csec)	CTS waiting time for DNP communications
	CARR. WAIT. TIM.(csec)	CARRIER waiting time for DNP communications
	STABIL TIME . (csec)	Stabilization time for DNP communications
	ACK. WAIT. TIME(csec)	Link acknowledge waiting time for DNP
	SYNCHRO. TIME. (min)	Synchronization time for DNP communications
	LINK ACK.	Link acknowledge for DNP communications
	AP. MESS BYTE N.	N. bytes of application messages for DNP
	T.CHANGES	Changes sending time for DNP communications
	T.FROZEN	Counter freezing time for DNP
	STATUS SEND	Status sending for DNP communications
	MEAS. BITS NUM.	Measurements format for DNP communications
	COUNT. BITS NUM.	Counter format for DNP communications
	NON REQUEST. MESS.	Non requested message sending for DNP
	PREV.CONFLICT	Conflict prev. for DNP communications
	FIXED COL. TIME (csec)	Fixed conflict time for DNP communications
	VBLE. COL. TIME (csec)	Variable conflict time for DNP
	T.RESEND	Non requested messages resend time for DNP
	N.MAX.NO REQUEST.	Max. non requested messages number for DNP
	SPECIAL	Special for DNP communications
	MEASURES FORMAT	Counts/value in the secondary/value inl the primary
	T.POSTTR	Posttransmssion time
REAR PORT	ADDRESS	UCL Address for communications SAP20
(If SAP20 programmed	BAUD RATE	Baud rate in the SAP20 communication
	CTS	(Hundredths of seconds.)
	AC. POR T.	Carrier activation time (Hundredths of seconds)
	DELTA 1	(Hundredths of seconds.)
	DELTA 4	(Hundredths of seconds.)
	Reb. De. N	Number for deactivation by rebounces
	Reb. Ac. T.	Rebounce activation time
	R. reac. .	Number for reactivation by rebounces
REAR PORT	ADDRESS	Remote address for 101 communications
(If 101 programmed)	APPL. ADDR	Application address for 101 communications
	BALANCED	Balanced mode
	Tipo Can	Channel type, connection
	BAUDRATE	Baud rate in the 101 communication
	PARITY	Parity in the 101 communication
	STOP BIT.	STOP BIT in the 101 communication
	POR.W.T.	Carrier time
	RTS T.A.	RTS activation time
	T.DE.RTS	RTS deactivation time
	CTS W.T.	CTS waiting time
	CD DEA.T.	TCD activation time

		RTS+CTS		RTS and CTS Control	
		MEA.CH.T		Measurement change time	
		ORD BUFF.		Order buffer size	
		RESP W.T.		Response waiting time	
		TR. MIN. T.		Minimum time between transmissions	
		RETRAN.T		Number of retransmissions	
		FIAB.TIM		Period for LinkTtest(sec)	
		QEUE1.F		% filling queue 1	
		QEUE1.D		% dumping queue 2	
		QEUE2.ER		Delete queue 2	
		Reb.De.N		*Number for the deactivation due to rebounces*	
		Reb.Ac.T		*Rebounce activation time*	
		R.Reac.N		*Number for the reactivation due to rebounces*	
		STA1 IOA		IOA 1st point simple states (1)	
		STA2 IOA		IOA 1st point simple states (2)	
		DSTA IOA		IOA 1st point double states	
		MEAS.IOA		IOA 1st point measurement	
		FU.Q IOA		IOA 1st point full queue	
		MF.Q IOA		IOA 1st point semifull queue	
		FIAB IOA		IOA 1st point reliability	
		FI.H.IOA		IOA Reliable time	
		IOA BY.N		NUM.Bytes IOA	
	TCP/IP	SEE COM TCPIP		TCPIP P.	See TCP/IP communications (NO, PROCOME)
		SEE PAR TCPIP		PROCOME PARAM.	ADDRESS

SETPOINTS (change)	DATE/TIME (change)				
Enter KEYWORD	ACTIVATE TABLE	TABLE 1 ?			Make table 1 active.
↑↑↓↓		TABLE 2 ?			Make table 2 active.
		TABLE 3?			Make table 3 active.
		TABLE 4?			Make table 4 active.
SETPOINTS (change)	TABLE 1(change)	SUPERVI. BREAKER	E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OCR	PHASE DF T.U.	ENABLED	Enable time phase fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			GND DF T.U.	ENABLED	Enable time neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			S.GND DF T.U.	ENABLED	Enable time sensitive neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			PHASE DF INST	ENABLED	Enable instantaneous phase fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			GND DF INST	ENABLED	Enable instantaneous neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			S.GND DF INST	ENABLED	Enable instantaneous sensitive neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			DF GENERAL	Vvp LEV.	Voltage presence level
				FAU.M.T.	Fault memory time
				V.TIME	Restoration voltage presence minimum time
				L.TIME	Light signal restoration time
				Vva LEV.	Voltage ausence level

				THRESH %	Voltage presence/ausence threshold (%)
				R.T.R.S.	Restore Time of Remote control Signal (sec)
			EXTING.CURRENT	PHS.CUR.	Phases extinguish current
				NEUT.CUR	Neutral extinguish current
				SNEU.CUR	Sensitive neutral extinguish current
			RESTRAIN HARM.2	PHS.ENAB	Phases enable
				GND.ENAB	Neutral enable
				THRESH %	I2f/If threshold (%)
				P.MIN.C.	Phase minimum current
				G.MIN.C.	Neutral minimum current
			DF AUTOMAT	RECL.N.	Recloser number
				T1 TIME	Time T1 (sec.)
				T2 TIME	Time T2 (sec.)
				T3 TIME	Time T3 (sec.)
		OPERATION LOGIC	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (change)	AS TABLE 1			
	TABLE 3 (change)	AS TABLE 1			
	TABLE 4 (change)	AS TABLE 1			

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL	PH. RATIO		Phase current transformation ratio
			GND RATIO		Neutral current transformation ratio
			VOL. RAT		Voltage transformation ratio
			NOMINALVOLTAGE		Nominal voltage
			TIME UNKNOWN 52	TIME UNKNOWN 52	Timing of the unknown state 52
			SLACK SPRINGS		Slacks spring
			LANGUAGE		Spanish/English
			PHS.CUR. S.LIMIT	PHS.CUR.	Programmable phase current measurements scale limit
			NEUT.CUR S.LIMIT	NEUT.CUR	Programmable neutral current measurements scale limit
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter keyword ↑↓.┘┘	FREQUEN.		50 / 60 Hz
			CAL SET		For exclusive use of INGETEAM Technology SA
			DELETE?		Resets the event, fault, osillograph queues
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			BACK	ADDRESS	UCL address for Gestel communications
			(if Gestel)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				Dir.log.	Remote station logical direction
				Prio.Al.	Remote station alarm priority
				P.A.Arr.	Remote station alarm priority when picking up

SETPOINTS (change)	TABLE 0 (change)	CONFIG.COMMUNIC.	BACK	ADDRESS	UCL address for Gestel communications
			(if PID1)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				T.ac.Sil	Line silence activation time (sec.)
				P.G.Cam.	Change general request
				D.Sen.F.	Reliability signal address
				T.c.Sen.	Reliability signalchange time
				P.Sincr.	Synchronsm permission
			PORT COM2	LCU ADDRESS	LCU address for DNP communications
			(If DNP)	MASTER ADDRESS	Master address for DNP communications
				BAUD RATE	Baud rate for DNP communications
				TYPE OF PARITY	Parity for DNP communications
				STOP ITS	Stop bits for DNP communications
				FIXED RTS	YES/NO
				RTS AND CTS CTRL	RTS and CTS control for DNP communications
				CTS. WAIT. TIME(csec)	CTS waiting time for DNP communications
				CARR. WAIT. TIM.(csec)	CARRIER waiting time for DNP communications
				STABIL TIME . (csec)	Stabilization time for DNP communications
				ACK. WAIT. TIME(csec)	Link acknowledge waiting time for DNP
				SYNCHRO. TIME. (min)	Synchronization time for DNP communications
				LINK ACK.	Link acknowledge for DNP communications
				AP. MESS BYTE N.	N. bytes of application messages for DNP
				T.CHANGES	Changes sending time for DNP communications
				T.FROZEN	Counter freezing time for DNP
				STATUS SEND	Status sending for DNP communications
				MEAS. BITS NUM.	Measurements format for DNP communications
				COUNT. BITS NUM.	Counter format for DNP communications
				NON REQUEST. MESS.	Non requested message sending for DNP
				PREV.CONFLICT	Conflict prev. for DNP communications
				FIXED COL. TIME (csec)	Fixed conflict time for DNP communications
				VBLE. COL. TIME (csec)	Variable conflict time for DNP
				T.RESEND	Non requested messages resend time for DNP
				N.MAX.NO REQUEST.	Max. non requested messages number for DNP
				SPECIAL	Special for DNP communications
				MEASURES FORMAT	Counts/value in the secondary/value inl the primary
				T.POSTTR	Posttransmssion time
			REAR PORT	ADDRESS	LCU address for SAP20 communications
			(If SAP20 programmed)	BAUD RATE	Baud rate in the SAP20 communication
				CTS	(Hundredths of seconds.)
				AC. POR T.	Carrier activation time (Hundredths of seconds)
				DELTA 1	(Hundredths of seconds.)
				DELTA 4	(Hundredths of seconds.)
				Reb. De. N	Number for deactivation by rebounces
				Reb. Ac. T.	Rebounce activation time
				R. reac. .	Number for reactivation by rebounces
			REAR PORT	ADDRESS	Remote address for 101 communications
			(If 101 programmed)	APPL. ADDR	Application address for 101 communications
				BALANCED	Balanced mode
				Tipo Can	Channel type, connection
				BAUDRATE	Baud rate in the 101 communication
				PARITY	Parity in the 101 communication
				STOP BIT.	STOP BIT in the 101 communication
				POR.W.T.	Carrier time
				RTS T.A.	RTS activation time
				T.DE.RTS	RTS deactivation time
				CTS W.T.	CTS waiting time
				CD DEA.T.	TCD activation time
			TRANS T.	Transmission time	

				RTS+CTS	RTS and CTS Control	
				MEA.CH.T	Measurement change time	
				ORD BUFF.	Order buffer size	
				RESP W.T.	Response waiting time	
				TR. MIN. T.	Minimum time between transmissions	
				RETRAN.T	Number of retransmissions	
				FIAB.TIM	Period for LinkTtest(sec)	
				QEUE1.F	% filling queue 1	
				QEUE1.D	% dumping queue 2	
				QEUE2.ER	Delete queue 2	
				Reb.De.N	*Number for the deactivation due to rebounces*	
				Reb.Ac.T	*Rebounce activation time*	
				R.Reac.N	*Number for the reactivation due to rebounces*	
				STA1 IOA	IOA 1st point simple states (1)	
				STA2 IOA	IOA 1st point simple states (2)	
				DSTA IOA	IOA 1st point double states	
				MEAS.IOA	IOA 1st point measurement	
				FU.Q IOA	IOA 1st point full queue	
				MF.Q IOA	IOA 1st point semifull queue	
				FIAB IOA	IOA 1st point reliability	
				FI.H.IOA	IOA Reliable time	
				IOA BY.N	NUM.Bytes IOA	
			TCP/IP	TCPIP COM SELEC	TCPIP P.	Select TCP/IP communications (NO, PROCOME)
				PG.TCPIP PARAM	PROCOME PARAM.	ADDRESS
SETPOINTS (change)	COUNTER SETTING	OPEN=0?				

APPENDIX VII. KEYBOARD / DISPLAY (BLOCK OF RC FAMILY)

In the following pages we enclose a table in which the details and available settings in units belonging to the RC family are indicated.

DATE/TIME (see)					Units date and time are visualized.
SEE ACTIVE TABLE					Present active table
INPUTS	INP. STAT				Status of inputs 1 and 2
	(3 and 4)				Status of inputs 3 and 4
	(5 and 6)				Status of inputs 5 and 6
	(7 and 8)				Status of inputs7 and 8
DIG. OUT	OUT.STAT.				Status of outputs 1 and 2
	(3 and 4)				Status of outputs 3 and4
	(5 y 6)				Status of outputs 5 and 6
	(7 and 8)				Status of outputs 7 and 8
	(9 and 10)				Status of outputs9 and10
	(11)				Status of output11
MEASURES	See page 4				
STATIST. DATA	See page 4				
LAST FAULTS	See page 4				
SETPOINTS (read)	See page 6				
SETPOINTS (change)	See page 15				
RECLOSER ON/OFF					Recloser On /Off

MEASUREMENTS	SECONDARY MEASUR	Pha.A (A)			Phase A current.
		Pha.C (A)			Phase C current
		GND (A)			Neutral current
		V (V)			Voltage
		MAX. (A)			Maximum average current in an interval t
		(%) NEG SEQ			Reverse component (%)
	PRIMARY MEASURES	Pha.A (A)			Phase A current.
		Pha.C (A)			Phase C current
		GND (A)			Neutral current
		V (V)			Voltage
		MAX. (A)			Maximum average current in an interval t
	AUXIL. MEASURES	Vsup 3, 3V			Supply internal measurement 3.3V
		Vbat3, 3V			Battery internal measurement 3.3V
		Extern V			Supply external measurement
		TEMP (ºC)			Unit temperature (ºC)
STATIS. DATA	TOT REC				Total number of reclosures.
	FIRS REC				Number of first reclosures.
	SECO REC				Number of second reclosures.
	THIR REC				Number of third reclosures.
	FOUR REC				Number of fourth reclosures.
	OPEN No.				Total number of trips given by the protection.
	KI2 P(A)				KI2 sum for maintenance, phase A
	KI2 P(B)				KI2 sum for maintenance, phase B
	KI2 P(C)				KI2 sum for maintenance, phase C
LAST FAULTS	FAULT n	TYPE			Phase/s involved in the last fault.
		Fau Ph A			Phase A current when the fault occurred (S).
		Fau Ph.B			Phase B current when the fault occurred (S).
		Fau Ph.C			Phase C current when the fault occurred (S).).
		Faul GND			Neutral current when the fault occurred (S)
		START T			Fault start date and time.
		END T			Fault end date and time.
		LedReset			Fault acknowledgement to switch off the Led.

SETPOINTS (see)	TABLE 1 (see)	PROTECT	PHASES TOC	ENABLED	Phase TOC
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			GROUND TOC	ENABLED	Ground TOC
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			S.GND TOC	ENABLED	Sensitive Ground TOC
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			PHASES IOC	ENABLED	Phase IOC (low level)
				PICKUP	
				FIX TIME	
				BLOCKING	
			GROUND TOC	ENABLED	Ground IOC (low level)
				PICKUP	
				FIX TIME	
				BLOCKING	
			S.GND TOC	ENABLED	Sensitive Ground IOC
				PICKUP	
				FIX TIME	
				BLOCKING	

SETPOINTS (see)	TABLE 1 (see)	RECLOS	RECLOSER. ON/OFF	RECLO.ON	Recloser in service/out of service.
			RECLOSE	T. RE1, P	1st closure time for phase to phase faults.
				T. RE1,T	1st closure time for phase to earth faults.
				T. RE2,P	2nd closure time for phase to phase faults.
				T. RE2,T	2nd closure time for phase to earth faults.
				T. RE3,P	3rd closure time for phase to phase faults.
				T. RE3,T	3rd closure time for phase to earth faults.
				T. RE4,P	4th closure time for phase to phase faults.
				T. RE4,T	4th closure time for phase to earth faults.
			DIVERSE TIMES	WAIT.Vref	Voltage reference waiting time.
				S.P.F.T	Reclaim time for faults.
				S.G.F.T	Reclaim time for GND.
				S.M.CL.T	Security time after manual closing.
			CYCLE CONTROL	RECL.NUM	No. of closures allowed.
			TRIP ENABLE	AT REST	Trip permission at rest
				Af.REC.1	Trips allowed after first reclosure.
				Af.REC.2	Trips allowed after second reclosure.
				Af.REC.3	Trips allowed after third reclosure.
				Af.REC.4	Trips allowed after fourth reclosure.
				Af.M.CL	Trips allowed after manual closure.
			RECLOSE ENABLE	Af.P.TOC	Allowed recl. after tripping due to phase toc.
				Af.G.TOC	Allowed recl. after tripping due to neutral toc.
				Af.IOC F	Allowed recl. after tripping due to phase ioc
				Af.G.IOC	Allowed recl. after tripping due to neutral ioc.
				Af.EXT.P	
			RECLOS SEQ.COORD	ENABLED	Sequence coordination
			RECLOSER BLOCK.C.		Recloser locking conditions.

SETPOINTS (see)	TABLE 1 (see)	BREAKER	EX.TR.N.		Excessive number of trips.
			WI.TR.N		Time for counting excessive number of trips
			AlarmKI2		KI2 sum alarm for maintenance.
			Init KI2		Initial KI2 sum(settings).
			E.T.C.SV		Trip circuit monitoring enable.
			E.C.C.SV		Close circuit monitoring enable.
		OCR	PHASE DF T.U.	ENABLED	Enable time phase fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			GND DF T.U.	ENABLED	Enable time neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			S.GND DF T.U.	ENABLED	Enable time sensitive neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			PHASE DF INST	ENABLED	Enable instantaneous phase fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			GND DF INST	ENABLED	Enable instantaneous neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			S.GND DF INST	ENABLED	Enable instantaneous sensitive neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			DF GENERAL	Vvp LEV.	Voltage presence level
				FAU.M.T.	Fault memory time
				V.TIME	Restoration voltage presence minimum time
				L.TIME	Light signal restoration time
				Vva LEV.	Voltage ausence level
				THRESH %	Voltage presence/ausence threshold (%)
				R.T.R.S.	Restore Time of Remote control Signal (sec)
			EXTING.CURRENT	PHS.CUR.	Phases extinguish current
				NEUT.CUR	Neutral extinguish current
				SNEU.CUR	Sensitive neutral extinguish current
			RESTRAIN HARM.2	PHS.ENAB	Phases enable
				GND.ENAB	Neutral enable
				THRESH %	I2f/If threshold (%)
				P.MIN.C.	Phase minimum current
				G.MIN.C.	Neutral minimum current
		OPERAT	TRIP LATCH		Trip locking.
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (see)	SAME AS TABLE 1			
	TABLE 3 (see)	SAME AS TABLE 1			
	TABLE 4 (see)	SAME AS TABLE 1			

SETPOINTS (see)	TABLE 0 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL.	PH.RATIO		Phase current transformatio ratio
			GNDRATIO		Ground current transformatio ratio.
			VOL. RAT		Voltage transformation ratio
			NOMINALVOLATAGE		Nominal voltage
			SPRING SLACKS		Spring slacks
			LANGUAGE		Spanish/English
			PHS.CUR. S.LIMIT	PHS.CUR.	Programmable phase current measurements scale limit
			NEUT.CUR S.LIMIT	NEUT.CUR	Programmable neutral current measurements scale limit
			FAULT.M.		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
			FREQUEN.		50 / 60 Hz
			FEEDING SUPERVI.		Enable feeding supervision
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (even) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (even) yes or no.
				STOP BIT	Number of STOP BITS
				CTRL. SEN.	RTS Control
			CONFIG. GESTEL	ADDRESS	LCU address for Gestel communications
			(If Gestel programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (even) yes or no.
				CTS	(Hund. Sec.)
				Chan. Typ	Channel type (Normal or RTC/GSM)
				AC.POR T.	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				Dir.log.	Remote station logical direction
				Prio.Al.	Remote station alarm priority
				P.A.Arr.	Remote station alarm priority when picking up

			CONFIG. PID1	ADDRESS	UCL address for Gestel communications
			(if PID1 programmed)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				T.ac.Sil	Line silence activation time (sec.)
				P.G.Cam.	Change general request
				D.Sen.F.	Reliability signal address
				T.c.Sen.	Reliability signalchange time
				P.Sincr.	Synchronsm permission
			PORT COM2	LCU ADDRESS	LCU address for DNP communications
			(If DNP)	MASTER ADDRESS	Master address for DNP communications
				BAUD RATE	Baud rate for DNP communications
				TYPE OF PARITY	Parity for DNP communications
				STOP ITS	Stop bits for DNP communications
				FIXED RTS	YES/NO
				RTS AND CTS CTRL	RTS and CTS control for DNP communications
				CTS. WAIT. TIME(csec)	CTS waiting time for DNP communications
				CARR. WAIT. TIM.(csec)	CARRIER waiting time for DNP communications
				STABIL TIME . (csec)	Stabilization time for DNP communications
				ACK. WAIT. TIME(csec)	Link acknowledge waiting time for DNP
				SYNCHRO. TIME. (min)	Synchronization time for DNP communications
				LINK ACK.	Link acknowledge for DNP communications
				AP. MESS BYTE N.	N. bytes of application messages for DNP
				T.CHANGES	Changes sending time for DNP communications
				T.FROZEN	Counter freezing time for DNP
				STATUS SEND	Status sending for DNP communications
				MEAS. BITS NUM.	Measurements format for DNP communications
				COUNT. BITS NUM.	Counter format for DNP communications
				NON REQUEST. MESS.	Non requested message sending for DNP
				PREV.CONFLICT	Conflict prev. for DNP communications
				FIXED COL. TIME (csec)	Fixed conflict time for DNP communications
				VBLE. COL. TIME (csec)	Variable conflict time for DNP
				T.RESEND	Non requested messages resend time for DNP
				N.MAX.NO REQUEST.	Max. non requested messages number for DNP
				SPECIAL	Special for DNP communications
				MEASURES FORMAT	Counts/value in the secondary/value inI the primary
				T.POSTTR	Posttransmssion time
			REAR PORT	ADDRESS	UCL Address for communications SAP20
			(If SAP20 programmed	BAUD RATE	Baud rate in the SAP20 communication
				CTS	(Hundredths of seconds.)
				AC. POR T.	Carrier activation time (Hundredths of seconds)
				DELTA 1	(Hundredths of seconds.)
				DELTA 4	(Hundredths of seconds.)
				Reb. De. N	Number for deactivation by rebounces
				Reb. Ac. T.	Rebounce activation time
				R. reac. .	Number for reactivation by rebounces
			REAR PORT	ADDRESS	Remote address for 101 communications
			(If 101 programmed)	APPL. ADDR	Application address for 101 communications
				BALANCED	Balanced mode
				Tipo Can	Channel type, connection
				BAUDRATE	Baud rate in the 101 communication
				PARITY	Parity in the 101 communication
				STOP BIT.	STOP BIT in the 101 communication
				POR.W.T.	Carrier time
				RTS T.A.	RTS activation time
				T.DE.RTS	RTS deactivation time
				CTS W.T.	CTS waiting time
				CD DEA.T.	TCD activation time

				TRANS T.	Transmission time
				MEA.CH.T	Measurement change time
				ORD BUFF.	Order buffer size
				RESP W.T.	Response waiting time
				TR. MIN. T.	Minimum time between transmissions
				RETRAN.T	Number of retransmissions
				FIAB.TIM	Period for LinkTtest(sec)
				QEUE1.F	% filling queue 1
				QEUE1.D	% dumping queue 2
				QEUE2.ER	Delete queue 2
				Reb.De.N	Number for the deactivation due to rebounces
				Reb.Ac.T	Rebounce activation time
				R.Reac.N	Number for the reactivation due to rebounces
				STA1 IOA	IOA 1st point simple states (1)
				STA2 IOA	IOA 1st point simple states (2)
				DSTA IOA	IOA 1st point double states
				MEAS.IOA	IOA 1st point measurement
				FU.Q IOA	IOA 1st point full queue
				MF.Q IOA	IOA 1st point semifull queue
				FIAB IOA	IOA 1st point reliability
				FI.H.IOA	IOA Reliable time
				IOA BY.N	NUM.Bytes IOA
			TCP/IP	SEE COM TCPIP	TCPIP P. -> See TCP/IP communications (NO, PROCOME)
				SEE PAR TCPIP	PROCOME PARAM. -> ADDRESS

SETPOINTS(change)	DATE/ TIME (change)				
Enter KEYWORD	ACTIVATE TABLE	TABLE 1 ?			Make table 1 active
↑↑↓↓		TABLE 2 ?			Make table 2 active
		TABLE 3?			Make table 3 active
		TABLE 4?			Make table 4 active
SETPOINTS(change)	TABLE 1 (change)	PROTECTION	PHASE TOC	ENABLED	Phases time
				PICKUP	
				CURVE	
				TIME DIAL	
				FIX TIME	
				BLOCKING	Ground time
			GND TOC	ENABLED	
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	Residual current time
			S.GND TOC	ENABLED	Sensitive Ground TOC
				PICKUP	
				CURVE	
				INDEX	
				FIX TIME	
				BLOCKING	
			PHASES IOC	ENABLED	Phase instantaneous (low level)
				PICKUP	
				FIX TIME	
				BLOCKING	
			GROUND TOC	ENABLED	Ground instantaneous (low level)
				PICKUP	
				FIX TIME	
				BLOCKING	
			S.GND TOC	ENABLED	Sensitive Ground IOC
				PICKUP	
				FIX TIME	
				BLOCKING	

SETPOINTS(change)	TABLE 1 (change)	RECLOSER	RECLOSER. ON/OFF	RECLO.ON	Recloser on/off

			RECLOS. TIME	T. RE1, P	Recloser 1st for faults among phases
				T. RE1,T	Recloser 1st for faults to ground
				T. RE2,P	Recloser 2nd for faults among phases
				T. RE2,T	Recloser 2nd for faults to ground
				T. RE3,P	Recloser 3rd for faults among phases
				T. RE3,T	Recloser 3rd for faults to ground
				T. RE4,P	Recloser 4th for faults among phases
				T. RE4,T	Recloser 4th for faults to ground
			DIVERSE TIMES	WAIT.Vref	Reference voltage waiting time
				S.P.F.T	Security time for faults
				S.G.F.T	Security time for GND.
				S.M.CL.T	Security time after manual close.
			CYCLE CONTROL	RECL.NUM	Number of permitted reclosers.
			TRIP ENABLE	AT REST	Permitted trips at rest
				Af.REC.1	Permitted trips after first recloser
				Af.REC.2	Permitted trips after second recloser
				Af.REC.3	Permitted trips after third recloser
				Af.REC.4	Permitted trips after fourth recloser.
				Af.M.CL	Permitted trips after manual close.
			RECLOSE ENABLE	Af.P.TOC	Allowed reclosures after tripping due to phase toc.
				Af.G.TOC	Allowed reclo. after tripping due to neutral toc.
				Tr.IOC F	Allowed reclo. after fter tripping due to phase ioc
				Af.G.IOC	Allowed reclo. after tripping due to neutral ioc.
				F.H.IOC	Allowed reclo. after tripping due to High phases instant.
				F.N. IOC	Allowed reclo. after tripping due to High neutral instant
				Af.OP.PH	Allowed reclo. after tripping due to Broken Conductor
				Af.EXT.P	Allowed reclo. after external actuation
			RECLOS SEQ.CORD	ENABLED	Sequence coordination
			RECLOSER BLOCK.C.		Recloser locking conditions.

SETPOINTS(change)	TABLE 1 (change)	BREAKER	EX.TR.N.		Excessive number of trips.
			WI.TR.N		Time due to excessive number of trips.
			AlarmKI2		Alarm sigma KI2 for maintenance
			Init KI2		Initial sigma KI2(setting).
			E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OCR	PHASE DF T.U.	ENABLED	Enable time phase fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			GND DF T.U.	ENABLED	Enable time neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			S.GND DF T.U.	ENABLED	Enable time sensitive neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
			PHASE DF INST	ENABLED	Enable instantaneous phase fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			GND DF INST	ENABLED	Enable instantaneous neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			S.GND DF INST	ENABLED	Enable instantaneous sensitive neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
			DF GENERAL	Vvp LEV.	Voltage presence level
				FAU.M.T.	Fault memory time
				V.TIME	Restoration voltage presence minimum time
				L.TIME	Light signal restoration time
				Vva LEV.	Voltage ausence level
				THRESH %	Voltage presence/ausence threshold (%)
				R.T.R.S.	Restore Time of Remote control Signal (sec)
			EXTING.CURRENT	PHS.CUR.	Phases extinguish current
				NEUT.CUR	Neutral extinguish current
				SNEU.CUR	Sensitive neutral extinguish current
			RESTRAIN HARM.2	PHS.ENAB	Phases enable
				GND.ENAB	Neutral enable
				THRESH %	I2f/If threshold (%)

				P.MIN.C.	Phase minimum current
				G.MIN.C.	Neutral minimum current
		OPERAT	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
	TABLE 2 (see)	SAME AS TABLE 1			
	TABLE 3 (see)	SAME AS TABLE 1			
	TABLE 4 (see)	SAME AS TABLE 1			

SETPOINTS(change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 11	11 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Conf. of the 7 program. leds (function and type)
		GENERAL.	PH.RATIO		Phase current transformatio ratio
			GND RATIO		Ground current transformatio ratio.
			R.T.SGND		Sensistive ground current transformatio ratio.
			LANGUAGE		Spanish/English
			PHS.CUR. S.LIMIT	PHS.CUR.	Programmable phase current measurements scale limit
			NEUT.CUR S.LIMIT	NEUT.CUR	Programmable neutral current measurements scale limit
			FAULT MEASURE		Primary/Secondary
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter keyword ↑↓⌟⌟	FREQUEN.		50 / 60 Hz
			CAL SET		For exclusive use of INGETEAM TRANSMISSION & DISTRIBUTION SA
			DELETES?		Reset the events, faults and oscillo queues
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (even) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (even) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			CONFIG. GESTEL	ADDRESS	LCU address for Gestel communications
			(If Gestel programmed)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (even) yes or no.
				CTS	(Hund. Sec.)
				Chan. Typ	Channel type (Normal or RTC/GSM)
				AC.POR T.	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				Dir.log.	Remote station logical direction
				Prio.Al.	Remote station alarm priority
				P.A.Arr.	Remote station alarm priority when picking up
SETPOINTS(change)	TABLE 0 (change)		CONFIG. PID1	ADDRESS	UCL address for Gestel communications
			(if PID1 programmed)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				T.ac.Sil	Line silence activation time (sec.)
				P.G.Cam.	Change general request

				D.Sen.F.	Reliability signal address
				T.c.Sen.	Reliability signalchange time
				P.Sincr.	Synchronsm permission
			PORT COM2	LCU ADDRESS	LCU address for DNP communications
			(If DNP)	MASTER ADDRESS	Master address for DNP communications
				BAUD RATE	Baud rate for DNP communications
				TYPE OF PARITY	Parity for DNP communications
				STOP ITS	Stop bits for DNP communications
				FIXED RTS	YES/NO
				RTS AND CTS CTRL	RTS and CTS control for DNP communications
				CTS. WAIT. TIME(csec)	CTS waiting time for DNP communications
				CARR. WAIT. TIM.(csec)	CARRIER waiting time for DNP communications
				STABIL TIME . (csec)	Stabilization time for DNP communications
				ACK. WAIT. TIME(csec)	Link acknowledge waiting time for DNP
				SYNCHRO. TIME. (min)	Synchronization time for DNP communications
				LINK ACK.	Link acknowledge for DNP communications
				AP. MESS BYTE N.	N. bytes of application messages for DNP
				T.CHANGES	Changes sending time for DNP communications
				T.FROZEN	Counter freezing time for DNP
				STATUS SEND	Status sending for DNP communications
				MEAS. BITS NUM.	Measurements format for DNP communications
				COUNT. BITS NUM.	Counter format for DNP communications
				NON REQUEST. MESS.	Non requested message sending for DNP
				PREV.CONFLICT	Conflict prev. for DNP communications
				FIXED COL. TIME (csec)	Fixed conflict time for DNP communications
				VBLE. COL. TIME (csec)	Variable conflict time for DNP
				T.RESEND	Non requested messages resend time for DNP
				N.MAX.NO REQUEST.	Max. non requested messages number for DNP
				SPECIAL	Special for DNP communications
				MEASURES FORMAT	Counts/value in the secondary/value inI the primary
				T.POSTTR	Posttransmssion time
			REAR PORT	ADDRESS	LCU address for SAP20 communications
			(If SAP20 programmed)	BAUD RATE	Baud rate in the SAP20 communication
				CTS	(Hundredths of seconds.)
				AC. POR T.	Carrier activation time (Hundredths of seconds)
				DELTA 1	(Hundredths of seconds.)
				DELTA 4	(Hundredths of seconds.)
				Reb. De. N	Number for deactivation by rebounces
				Reb. Ac. T.	Rebounce activation time
				R. reac. .	Number for reactivation by rebounces
			REAR PORT	ADDRESS	Remote address for 101 communications
			(If 101 programmed)	APPL. ADDR	Application address for 101 communications
				BALANCED	Balanced mode
				Tipo Can	Channel type, connection
				BAUDRATE	Baud rate in the 101 communication
				PARITY	Parity in the 101 communication
				STOP BIT.	STOP BIT in the 101 communication
				POR.W.T.	Carrier time
				RTS T.A.	RTS activation time
				T.DE.RTS	RTS deactivation time
				CTS W.T.	CTS waiting time
				CD DEA.T.	TCD activation time
				TRANS T.	Transmission time
				RTS+CTS	RTS and CTS Control
				MEA.CH.T	Measurement change time
				ORD BUFF.	Order buffer size

				RESP W.T.	Response waiting time
				TR. MIN. T.	Minimum time between transmissions
				RETRAN.T	Number of retransmissions
				FIAB.TIM	Period for LinkTtest(sec)
				QEUE1.F	% filling queue 1
				QEUE1.D	% dumping queue 2
				QEUE2.ER	Delete queue 2
				Reb.De.N	Number for the deactivation due to rebounces
				Reb.Ac.T	Rebounce activation time
				R.Reac.N	Number for the reactivation due to rebounces
				STA1 IOA	IOA 1st point simple states (1)
				STA2 IOA	IOA 1st point simple states (2)
				DSTA IOA	IOA 1st point double states
				MEAS.IOA	IOA 1st point measurement
				FU.Q IOA	IOA 1st point full queue
				MF.Q IOA	IOA 1st point semifull queue
				FIAB IOA	IOA 1st point reliability
				FI.H.IOA	IOA Reliable time
				IOA BY.N	NUM.Bytes IOA
			TCP/IP	TCPIP COM SELEC	TCPIP P. -> Select TCP/IP communications (NO, PROCOME)
				PG.TCPIP PARAM	PROCOME PARAM. -> ADDRESS
	SETTING	OPEN=0?			Set opening counters to zero
		RECLOSE COUNT= 0 ?			Set reclosure and trip counters to zero
		MAX = 0 ?			Set maximeter to zero
		KI2(A) ?			Initial KI2 sum phase A with its value in the setting
		KI2(C) ?			Initial KI2 sum phase C with its value in the setting.

APPENDIX VIII. KEYBOARD / DISPLAY (BLOCK OF RS FAMILY)

In the following pages we enclose a table in which the details and available settings in units belonging to the RS family are indicated.

DATE/TIME (see)						Units date and time are visualized.
SEE ACTIVE TABLE						Present active table
DIG. INPU	INP. STAT					Status of inputs 1 and 2
	(1 and 2)					Status of inputs 1 and 2
	(3 and 4)					Status of inputs 3 and 4
	(5 and 6)					Status of inputs 5 and 6
	(7 and 8)					Status of inputs7 and 8
DIG. OUT	OUT.STAT.					Status of outputs 1 and 2
	(3 and 4)					Status of outputs 3 and4
	(5 and 6)					Status of outputs 5 and 6
	(7 and 8)					Status of outputs 7 and 8
	(9 and 10)					Status of outputs9 and10
	(11)					Status of output 11
MEASURES	See following pages					
STATIST. DATA	See following pages					
LAST FAULTS	See following pages					
SETPOINTS(read)	See following pages					

MEASURES	SECONDARY MEASUR	PhaseA (A)			Current in phase A.
		Phase C (A)			Current in phase fase C.
		Gnd (A)			Current in ground
		VA (kV)			A phase voltage (kV)
		VB (kV)			B phase voltage (kV)
		VC (kV)			C phase voltage (kV)
	PRIMARY MEASURES	Phase A (A)			Current in phase A in the primary
		Phase C (A)			Current in phase fase C in the primary
		Gnd. (A)			Current in ground in the primary
		VA (kV)			A phase voltage (kV)
		VB (kV)			B phase voltage (kV)
		VC (kV)			C phase voltage (kV)
	POWER MEASURES	ACTUAL P			Active power (secondary)
		IDLE POW			Reactive power (secondary)
		APP.POW.			Apparent power (secondary)
		LAG FACT			Power factor
	AUXIL. MEASURES.	Vsup 3, 3V			Supply internal measurement 3.3V
		Vbat3, 3V			Battery internal measurement 3.3V
		Extern V			Supply external measurement
		TEMP (ºC)			Unit temperature (ºC)
STATIS. DATA	OPEN No.				Number of total openings by the protection

SETPOINTS (see)	TABLE 1 (see)	SUPERVI. BREAKER	E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OCR	PHASE DF T.U.	ENABLED	Enable time phase fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
				TORQUE C.	Torque Control
			GND DF T.U.	ENABLED	Enable time neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
				TORQUE C.	Torque Control
			S.GND DF T.U.	ENABLED	Enable time sensitive neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
				TORQUE C.	Torque Control
			PHASE DF INST	ENABLED	Enable instantaneous phase fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
				TORQUE C.	Torque Control
			GND DF INST	ENABLED	Enable instantaneous neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
				TORQUE C.	Torque Control
			S.GND DF INST	ENABLED	Enable instantaneous sensitive neutral fault passover
				PICKUP	Pick up current
				FIX TIME	Additional timing
				TORQUE C.	Torque Control
			DF GENERAL	Vvp LEV.	Voltage presence level
				FAU.M.T.	Fault memory time
				V.TIME	Restoration voltage presence minimum time
				L.TIME	Light signal restoration time
				Vva LEV.	Voltage ausence level
				THRESH %	Voltage presence/ausence threshold (%)
				R.T.R.S.	Restore Time of Remote control Signal (sec)
			EXTING.CURRENT	PHS.CUR.	Phases extinguish current
				NEUT.CUR	Neutral extinguish current
				SNEU.CUR	Sensitive neutral extinguish current
			RESTRAIN HARM.2	PHS.ENAB	Phases enable
				GND.ENAB	Neutral enable
				THRESH %	I2f/If threshold (%)
				P.MIN.C.	Phase minimum current
				G.MIN.C.	Neutral minimum current
			DF AUTOMAT	RECL.N.	Recloser number
				T1 TIME	Time T1 (sec.)
				T2 TIME	Time T2 (sec.)
				T3 TIME	Time T3 (sec.)
		OPERATION LOGIC	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
		DIRECTIONALITY	PHS.DIR.	P.D.CRIT	Phase direction criteria
				PHS.ANGL	Phase angle (degrees)
				POL.V	Polarization voltage(V)
				PHS.Z.R	Phase zone width (degrees)
				TRIP PER.	Trip permission without Vpol
			NEUT.DIR	N.D.CRIT	Neutral direction criteria
				GND ANGL	Neutral angle (degrees)

				GND Z.R.	Neutral zone width (degrees)
				MIN.VN T	Vn minimun threshold
	TABLE 2 (see)	AS TABLE 1			
	TABLE 3 (see)	AS TABLE 1			
	TABLE 4 (see)	AS TABLE 1			

SETPOINTS (see)	TABLE 0 (see)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 6	6 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL	PH. RATIO		Phase current transformation ratio
			GND RATIO		Neutral current transformation ratio
			VOL. RAT		Voltage transformation ratio
			NOMINALVOLTAGE		Nominal voltage
			TIME UNKNOWN 52	TIME UNKNOWN 52	Timing of the unknown state 52
			SLACK SPRINGS		Spring slacks
			LANGUAGE		Spanish/English
			CORRECT. FACTOR	VA FACT	Phase A voltaje correction factor for bushing
				VB FACT	Phase B voltaje correction factor for bushing
				VC FACT	Phase C voltaje correction factor for bushing
			BUSHING CAPACIT.		Bushing capacity
			PHS.CUR.		Programmable phase current measurements scale limit
			NEUT.CUR		Programmable neutral current measurements scale limit
			LAMP		Lamp correction
			ANGLE C.		Angle correction
		SPECIAL	PH ORDER		A-B-C / C-B-A
			FREQUEN.		50 / 60 Hz
			EN.BUTT.		Enable pushbuttons
			FEEDING SUPERVI		Enable feeding supervision
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS,103
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			BACK	ADDRESS	UCL address for Gestel communications
			(if Gestel)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				Dir.log.	Remote station logical direction
				Prio.Al.	Remote station alarm priority
				P.A.Arr.	Remote station alarm priority when picking up

			CONFIG. PID1	ADDRESS	UCL address for Gestel communications
			(if PID1 programmed)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				T.ac.Sil	Line silence activation time (sec.)
				P.G.Cam.	Change general request
				D.Sen.F.	Reliability signal address
				T.c.Sen.	Reliability signalchange time
				P.Sincr.	Synchronsm permission
			PORT COM2	LCU ADDRESS	LCU address for DNP communications
			(If DNP)	MASTER ADDRESS	Master address for DNP communications
				BAUD RATE	Baud rate for DNP communications
				TYPE OF PARITY	Parity for DNP communications
				STOP ITS	Stop bits for DNP communications
				FIXED RTS	YES/NO
				RTS AND CTS CTRL	RTS and CTS control for DNP communications
				CTS. WAIT. TIME(csec)	CTS waiting time for DNP communications
				CARR. WAIT. TIM.(csec)	CARRIER waiting time for DNP communications
				STABIL TIME . (csec)	Stabilization time for DNP communications
				ACK. WAIT. TIME(csec)	Link acknowledge waiting time for DNP
				SYNCHRO. TIME. (min)	Synchronization time for DNP communications
				LINK ACK.	Link acknowledge for DNP communications
				AP. MESS BYTE N.	N. bytes of application messages for DNP
				T.CHANGES	Changes sending time for DNP communications
				T.FROZEN	Counter freezing time for DNP
				STATUS SEND	Status sending for DNP communications
				MEAS. BITS NUM.	Measurements format for DNP communications
				COUNT. BITS NUM.	Counter format for DNP communications
				NON REQUEST. MESS.	Non requested message sending for DNP
				PREV.CONFLICT	Conflict prev. for DNP communications
				FIXED COL. TIME (csec)	Fixed conflict time for DNP communications
				VBLE. COL. TIME (csec)	Variable conflict time for DNP
				T.RESEND	Non requested messages resend time for DNP
				N.MAX.NO REQUEST.	Max. non requested messages number for DNP
				SPECIAL	Special for DNP communications
				MEASURES FORMAT	Counts/value in the secondary/value inI the primary
				T.POSTTR	Posttransmssion time
			REAR PORT	ADDRESS	UCL Address for communications SAP20
			(If SAP20 programmed	BAUD RATE	Baud rate in the SAP20 communication
				CTS	(Hundredths of seconds.)
				AC. POR T.	Carrier activation time (Hundredths of seconds)
				DELTA 1	(Hundredths of seconds.)
				DELTA 4	(Hundredths of seconds.)
				Reb. De. N	Number for deactivation by rebounces
				Reb. Ac. T.	Rebounce activation time
				R. reac. .	Number for reactivation by rebounces
			REAR PORT	ADDRESS	Remote address for 101 communications
			(If 101 programmed)	APPL. ADDR	Application address for 101 communications
				BALANCED	Balanced mode
				Tipo Can	Channel type, connection
				BAUDRATE	Baud rate in the 101 communication
				PARITY	Parity in the 101 communication
				STOP BIT.	STOP BIT in the 101 communication
				POR.W.T.	Carrier time
				RTS T.A.	RTS activation time
				T.DE.RTS	RTS deactivation time
				CTS W.T.	CTS waiting time
				CD DEA.T.	TCD activation time

				TRANS T.	Transmission time
				RTS+CTS	RTS and CTS control
				MEA.CH.T	Measurement change time
				ORD BUFF.	Order buffer size
				RESP W.T.	Response waiting time
				TR. MIN. T.	Minimum time between transmissions
				RETRAN.T	Number of retransmissions
				FIAB.TIM	Period for LinkTtest(sec)
				QEUE1.F	% filling queue 1
				QEUE1.D	% dumping queue 2
				QEUE2.ER	Delete queue 2
				Reb.De.N	Number for the deactivation due to rebounces
				Reb.Ac.T	Rebounce activation time
				R.Reac.N	Number for the reactivation due to rebounces
				STA1 IOA	IOA 1st point simple states (1)
				STA2 IOA	IOA 1st point simple states (2)
				DSTA IOA	IOA 1st point double states
				MEAS.IOA	IOA 1st point measurement
				FU.Q IOA	IOA 1st point full queue
				MF.Q IOA	IOA 1st point semifull queue
				FIAB IOA	IOA 1st point reliability
				FI.H.IOA	IOA Reliable time
				IOA BY.N	NUM.Bytes IOA
			TCP/IP	SEE COM TCPIP	TCPIP P. -> See TCP/IP communications (NO, PROCOME)
				SEE PAR TCPIP	PROCOME PARAM. -> ADDRESS
			EN.ISOL.SW.AUT	AUT.ENAB	Mode 1 / Mode 2

SETPOINTS(change)	DATE/ TIME (change)				
Enter KEYWORD	ACTIVATE TABLE	TABLE 1 ?			Make table 1 active
↑↑↓↓		TABLE 2 ?			Make table 2 active
		TABLE 3?			Make table 3 active
		TABLE 4?			Make table 4 active
SETPOINTS(change)	TABLE 1 (change)	SUPERVI. BREAKER	E.T.C.SV		Enable trip circuit surveillance
			E.C.C.SV		Enable close circuit surveillance
		OCR	PHASE DF T.U.	ENABLED	Enable time phase fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
				TORQUE C	Torque Control
			GND DF T.U.	ENABLED	Enable time neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
				TORQUE C	Torque Control
			S.GND DF T.U.	ENABLED	Enable time sensitive neutral fault passover detection
				PICKUP	Pick up current
				CURVE	Curves
				INDEX	Index
				FIX TIME	Additional timing (s)
				TORQUE C	Torque Control
			PHASE DF INST	ENABLED	Enable instantaneous phase fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
				TORQUE C	Torque Control
			GND DF INST	ENABLED	Enable instantaneous neutral fault passover detection
				PICKUP	Pick up current

				FIX TIME	Additional timing
				TORQUE C	Torque Control
			S.GND DF INST	ENABLED	Enable instantaneous sensitive neutral fault passover detection
				PICKUP	Pick up current
				FIX TIME	Additional timing
				TORQUE C	Torque Control
			DF GENERAL	Vvp LEV.	Voltage presence level
				FAU.M.T.	Fault memory time
				V.TIME	Restoration voltage presence minimum time
				L.TIME	Light signal restoration time
				Vva LEV.	Voltage ausence level
				THRESH %	Voltage presence/ausence threshold (%)
				R.T.R.S.	Restore Time of Remote control Signal (sec)
			EXTING.CURRENT	PHS.CUR.	Phases extinguish current
				NEUT.CUR	Neutral extinguish current
				SNEU.CUR	Sensitive neutral extinguish current
			RESTRAIN HARM.2	PHS.ENAB	Phases enable
				GND.ENAB	Neutral enable
				THRESH %	I2f/If threshold (%)
				P.MIN.C.	Phase minimum current
				G.MIN.C.	Neutral minimum current
			DF AUTOMAT	RECL.N.	Recloser number
				T1 TIME	Time T1 (sec.)
				T2 TIME	Time T2 (sec.)
				T3 TIME	Time T3 (sec.)
		OPERATION LOGIC	TRIP LATCH		Trip latch
			OPEN FAIL T		Open failure time
			CLOS FAIL T		Close failure time
		DIRECTIONALITY	PHS.DIR.	P.D.CRIT	Phase direction criteria
				PHS.ANGL	Phase angle (degrees)
				POL.V	Polarization voltage(V)
				PHS.Z.R	Phase zone width (degrees)
				TRIP PER.	Trip permission without Vpol
			NEUT.DIR	N.D.CRIT	Neutral direction criteria
				GND ANGL	Neutral angle (degrees)
				GND Z.R.	Neutral zone width (degrees)
				MIN.VN T	Vn minimun threshold
	TABLE 2 (change)	AS TABLE 1			
	TABLE 3 (change)	AS TABLE 1			
	TABLE 4 (change)	AS TABLE 1			

SETPOINTS (change)	TABLE 0 (change)	CONFIGURAT I/O.	CONFIG. INPUTS	INPUT1- INPUT 8	8 input configuration
				SELECT NO/NC	
				INPUTS ACTIV.TI	Input filter
			OUTPUTS	OUTPUT1- OUTPUT 6	6 output configuration (function and type)
			OUTPUTS ACTIV.TI	OUTPUTS ACTIV.TI	
			LEDs	LED 1 to LED 7	Configuration of the 7 programmable leds (function and type)
		GENERAL	PH. RATIO		Phase current transformation ratio
			GND RATIO		Neutral current transformation ratio
			VOL. RAT		Voltage transformation ratio
			NOMINALVOLTAGE		Nominal voltage
			TIME UNKNOWN 52	TIME UNKNOWN 52	Timing of the unknown state 52
			SLACK SPRINGS		Slacks spring
			LANGUAGE		Spanish/English
			CORRECT. FACTOR	VA FACT	Phase A voltaje correction factor for bushing
				VB FACT	Phase B voltaje correction factor for bushing
				VC FACT	Phase C voltaje correction factor for bushing

			BUSHING CAPACIT.		Bushing capacity
			PHS.CUR.		Programmable phase current measurements scale limit
			NEUT.CUR		Programmable neutral current measurements scale limit
			LAMP CORRECT.	LAMP	Lamp correction
			ANGLE CORRECT.	ANGLE C.	Angle correction
		SPECIAL	PH ORDER		A-B-C / C-B-A
		Enter keyword ↑↓⌟⌟	FREQUEN.		50 / 60 Hz
			CAL SET		For exclusive use of INGETEAM Technology SA
			DELETE?		Resets the event, fault, osillograph queues
		CONFIG.COMMUNIC.	SELECT B COMMS		Procome, DNP, MODBUS
			FRONT	ADDRESS	Protection address
				BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
			BACK	ADDRESS	Protection address.
			(if Procome)	BAUD RATE	Baud rate (bauds).
				PARITY	Parity (par) yes or no.
				STOP BIT	Number of STOP BITS
				CTROL SIG	RTS signal
			BACK	ADDRESS	UCL address for Gestel communications
			(if Gestel)	BAUD RATE	Baud rate in Gestel communications
				PARITY	Parity Gestel communications
				CTS	(Hund. Sec.)
				Chan.Typ	Channel type (Normal or RTC/GSM)
				AC.POR.T	Carrier activation time (hund.sec)
				DELTA 1	(Hund. Sec.)
				DELTA 4	(Hund. Sec.)
				Dir.log.	Remote station logical direction
				Prio.Al.	Remote station alarm priority
				P.A.Arr.	Remote station alarm priority when picking up

SETPOINTS (change)	TABLE 0 (change)	CONFIG.COMMUNIC.	BACK	ADDRESS		UCL address for Gestel communications
			(if PID1)	BAUD RATE		Baud rate in Gestel communications
				PARITY		Parity Gestel communications
				CTS		(Hund. Sec.)
				Chan.Typ		Channel type (Normal or RTC/GSM)
				AC.POR.T		Carrier activation time (hund.sec)
				DELTA 1		(Hund. Sec.)
				DELTA 4		(Hund. Sec.)
				T.ac.Sil		Line silence activation time (sec.)
				P.G.Cam.		Change general request
				D.Sen.F.		Reliability signal address
				T.c.Sen.		Reliability signalchange time
				P.Sincr.		Synchronsm permission
			PORT COM2	LCU ADDRESS		LCU address for DNP communications
			(If DNP)	MASTER ADDRESS		Master address for DNP communications
				BAUD RATE		Baud rate for DNP communications
				TYPE OF PARITY		Parity for DNP communications
				STOP ITS		Stop bits for DNP communications
				FIXED RTS		YES/NO
				RTS AND CTS CTRL		RTS and CTS control for DNP communications
				CTS. WAIT. TIME(csec)		CTS waiting time for DNP communications
				CARR. WAIT. TIM.(csec)		CARRIER waiting time for DNP communications
				STABIL TIME . (csec)		Stabilization time for DNP communications

				ACK. WAIT. TIME(csec)		Link acknowledge waiting time for DNP
				SYNCHRO. TIME. (min)		Synchronization time for DNP communications
				LINK ACK.		Link acknowledge for DNP communications
				AP. MESS BYTE N.		N. bytes of application messages for DNP
				T.CHANGES		Changes sending time for DNP communications
				T.FROZEN		Counter freezing time for DNP
				STATUS SEND		Status sending for DNP communications
				MEAS. BITS NUM.		Measurements format for DNP communications
				COUNT. BITS NUM.		Counter format for DNP communications
				NON REQUEST. MESS.		Non requested message sending for DNP
				PREV.CONFLICT		Conflict prev. for DNP communications
				FIXED COL. TIME (csec)		Fixed conflict time for DNP communications
				VBLE. COL. TIME (csec)		Variable conflict time for DNP
				T.RESEND		Non requested messages resend time for DNP
				N.MAX.NO REQUEST.		Max. non requested messages number for DNP
				SPECIAL		Special for DNP communications
				MEASURES FORMAT		Counts/value in the secondary/value inI the primary
				T.POSTTR		Posttransmssion time
			REAR PORT	ADDRESS		LCU address for SAP20 communications
			(If SAP20 programmed)	BAUD RATE		Baud rate in the SAP20 communication
				CTS		(Hundredths of seconds.)
				AC. POR T.		Carrier activation time (Hundredths of seconds)
				DELTA 1		(Hundredths of seconds.)
				DELTA 4		(Hundredths of seconds.)
				Reb. De. N		Number for deactivation by rebounces
				Reb. Ac. T.		Rebounce activation time
				R. reac. .		Number for reactivation by rebounces
			REAR PORT	ADDRESS		Remote address for 101 communications
			(If 101 programmed)	APPL. ADDR		Application address for 101 communications
				BALANCED		Balanced mode
				Tipo Can		Channel type, connection
				BAUDRATE		Baud rate in the 101 communication
				PARITY		Parity in the 101 communication
				STOP BIT.		STOP BIT in the 101 communication
				POR.W.T.		Carrier time
				RTS T.A.		RTS activation time
				T.DE.RTS		RTS deactivation time
				CTS W.T.		CTS waiting time
				CD DEA.T.		TCD activation time
				TRANS T.		Transmission time
				RTS+CTS		RTS and CTS Control
				MEA.CH.T		Measurement change time
				ORD BUFF.		Order buffer size
				RESP W.T.		Response waiting time
				TR. MIN. T.		Minimum time between transmissions
				RETRAN.T		Number of retransmissions
				FIAB.TIM		Period for LinkTtest(sec)
				QEUE1.F		% filling queue 1
				QEUE1.D		% dumping queue 2
				QEUE2.ER		Delete queue 2
				Reb.De.N		Number for the deactivation due to rebounces
				Reb.Ac.T		Rebounce activation time
				R.Reac.N		Number for the reactivation due to rebounces
				STA1 IOA		IOA 1st point simple states (1)

				STA2 IOA		IOA 1st point simple states (2)
				DSTA IOA		IOA 1st point double states
				MEAS.IOA		IOA 1st point measurement
				FU.Q IOA		IOA 1st point full queue
				MF.Q IOA		IOA 1st point semifull queue
				FIAB IOA		IOA 1st point reliability
				FI.H.IOA		IOA Reliable time
				IOA BY.N		NUM.Bytes IOA
			TCP/IP	TCPIP COM SELEC	TCPIP P.	Select TCP/IP communications (NO, PROCOME)
				PG.TCPIP PARAM	PROCOME PARAM.	ADDRESS
			EN.ISOL.SW.AUT.	AUT.ENAB.		Mode1 / Mode 2
SETPOINTS (change)	COUNTER SETTING	OPEN=0?				

APPENDIX IX. CURVES FOR TIMED CHARACTERISTICS

IX.1. CURVES CEI 255-4 / BS142

Enclosed below are the groups of curves, according to BS142, which correspond to the following types:

Normal Inverse characteristic

Very Inverse characteristic.

Extremely Inverse characteristic.

User curve.

These curves comply with the general formula:

$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

being:

T: Trip time (sec)

T_{DROP} : Drop time (sec)

M: multiplier (“time index”). Valid range from 0.05 to 1.09 in steps of 0.01

I: Measured current

Io: Pickup current setting

K, α, constants which depend on the type of curve

Constant	Normal inverse	Short inverse	Long inverse	Very inverse	Extrem. inverse	MI Special
K	0.14	0.05	120	13.50	80.00	2.60
α	0.02	0.04	1	1.00	2.00	1.00
tr	9.7	0.5	120	43.2	58.2	21.2

The following represent the curves which correspond to indexes 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 for each type of characteristic. Bear in mind that there are another 9 curves between each of the two curves illustrated, except between 0.05 and 0.1, between which there are another 4.

Inverse curve

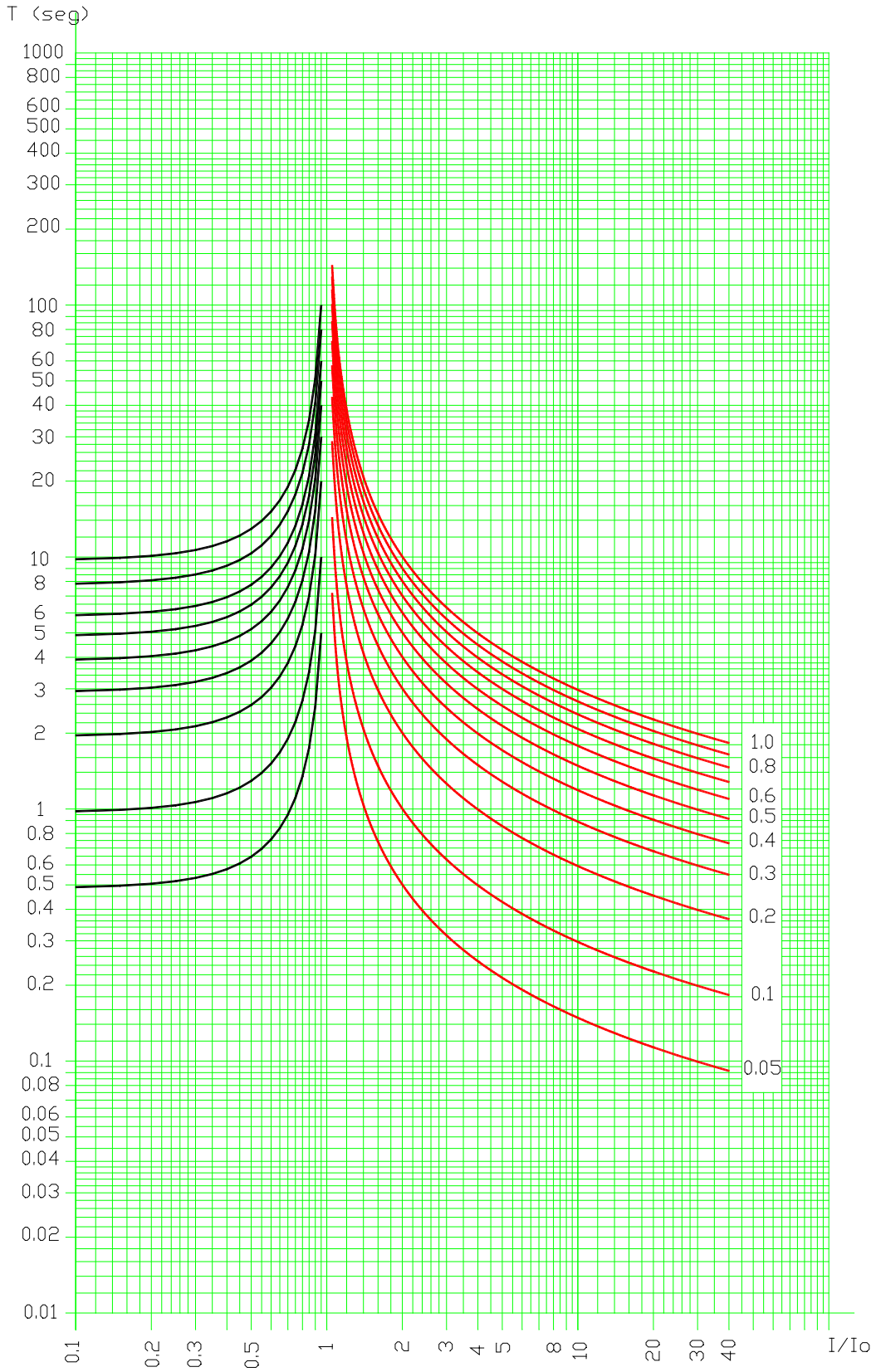
$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

K = 0,14, α = 0,02 **tr = 9.7**

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.05	0.485	0.517	0.647	1.109	7.170	3.669	1.916	1.331	0.860	0.501	0.378	0.315	0.214	0.149	0.113	0.091
0.06	0.582	0.621	0.776	1.330	8.604	4.402	2.299	1.597	1.032	0.602	0.454	0.378	0.257	0.178	0.136	0.110
0.07	0.679	0.724	0.905	1.552	10.038	5.136	2.683	1.863	1.204	0.702	0.530	0.441	0.300	0.208	0.159	0.128
0.08	0.776	0.828	1.035	1.774	11.472	5.870	3.066	2.129	1.376	0.802	0.606	0.504	0.342	0.238	0.181	0.146
0.09	0.873	0.931	1.164	1.995	12.906	6.604	3.449	2.395	1.547	0.903	0.681	0.567	0.385	0.267	0.204	0.165
0.10	0.970	1.035	1.293	2.217	14.340	7.337	3.832	2.661	1.719	1.003	0.757	0.630	0.428	0.297	0.227	0.183
0.11	1.067	1.138	1.423	2.439	15.774	8.071	4.216	2.927	1.891	1.103	0.833	0.693	0.471	0.327	0.249	0.201
0.12	1.164	1.242	1.552	2.661	17.208	8.805	4.599	3.193	2.063	1.203	0.908	0.756	0.514	0.356	0.272	0.219
0.13	1.261	1.345	1.681	2.882	18.642	9.539	4.982	3.459	2.235	1.304	0.984	0.819	0.556	0.386	0.295	0.238
0.14	1.358	1.449	1.811	3.104	20.076	10.272	5.365	3.725	2.407	1.404	1.060	0.882	0.599	0.416	0.317	0.256
0.15	1.455	1.552	1.940	3.326	21.510	11.006	5.749	3.992	2.579	1.504	1.135	0.945	0.642	0.446	0.340	0.274
0.16	1.552	1.655	2.069	3.547	22.944	11.740	6.132	4.258	2.751	1.605	1.211	1.008	0.685	0.475	0.363	0.293
0.17	1.649	1.759	2.199	3.769	24.378	12.474	6.515	4.524	2.923	1.705	1.287	1.071	0.728	0.505	0.385	0.311
0.18	1.746	1.862	2.328	3.991	25.812	13.207	6.898	4.790	3.095	1.805	1.363	1.134	0.770	0.535	0.408	0.329
0.19	1.843	1.966	2.457	4.213	27.246	13.941	7.282	5.056	3.267	1.906	1.438	1.197	0.813	0.564	0.431	0.347
0.20	1.940	2.069	2.587	4.434	28.680	14.675	7.665	5.322	3.439	2.006	1.514	1.260	0.856	0.594	0.453	0.366
0.25	2.425	2.587	3.233	5.543	35.850	18.344	9.581	6.653	4.299	2.507	1.892	1.575	1.070	0.743	0.567	0.457
0.30	2.910	3.104	3.880	6.651	43.021	22.012	11.497	7.983	5.158	3.009	2.271	1.891	1.284	0.891	0.680	0.549
0.35	3.395	3.621	4.527	7.760	50.191	25.681	13.413	9.314	6.018	3.510	2.649	2.206	1.498	1.040	0.794	0.640
0.40	3.880	4.139	5.173	8.869	57.361	29.350	15.329	10.644	6.878	4.012	3.028	2.521	1.712	1.188	0.907	0.731
0.45	4.365	4.656	5.820	9.977	64.531	33.018	17.246	11.975	7.737	4.513	3.406	2.836	1.926	1.337	1.020	0.823
0.50	4.850	5.173	6.467	11.086	71.701	36.687	19.162	13.305	8.597	5.015	3.785	3.151	2.140	1.485	1.134	0.914
0.55	5.335	5.691	7.113	12.194	78.871	40.356	21.078	14.636	9.457	5.516	4.163	3.466	2.354	1.634	1.247	1.006
0.60	5.820	6.208	7.760	13.303	86.041	44.025	22.994	15.966	10.317	6.017	4.542	3.781	2.568	1.782	1.360	1.097
0.65	6.305	6.725	8.407	14.411	93.211	47.693	24.910	17.297	11.176	6.519	4.920	4.096	2.782	1.931	1.474	1.188
0.70	6.790	7.243	9.053	15.520	100.381	51.362	26.827	18.627	12.036	7.020	5.299	4.411	2.996	2.079	1.587	1.280
0.75	7.275	7.760	9.700	16.629	107.551	55.031	28.743	19.958	12.896	7.522	5.677	4.726	3.210	2.228	1.701	1.371
0.80	7.760	8.277	10.347	17.737	114.721	58.700	30.659	21.288	13.755	8.023	6.056	5.042	3.424	2.376	1.814	1.463
0.85	8.245	8.795	10.993	18.846	121.891	62.368	32.575	22.619	14.615	8.525	6.434	5.357	3.638	2.525	1.927	1.554
0.90	8.730	9.312	11.640	19.954	129.062	66.037	34.491	23.949	15.475	9.026	6.813	5.672	3.852	2.674	2.041	1.646
0.95	9.215	9.829	12.287	21.063	136.232	69.706	36.408	25.280	16.335	9.528	7.191	5.987	4.066	2.822	2.154	1.737
1.00	9.700	10.347	12.933	22.171	143.402	73.374	38.324	26.611	17.194	10.029	7.570	6.302	4.280	2.971	2.267	1.828
1.05	10.185	10.864	13.580	23.280	150.572	77.043	40.240	27.941	18.054	10.530	7.948	6.617	4.494	3.119	2.381	1.920



INVERSE CHARACTERISTIC

Long duration curve (IEC)

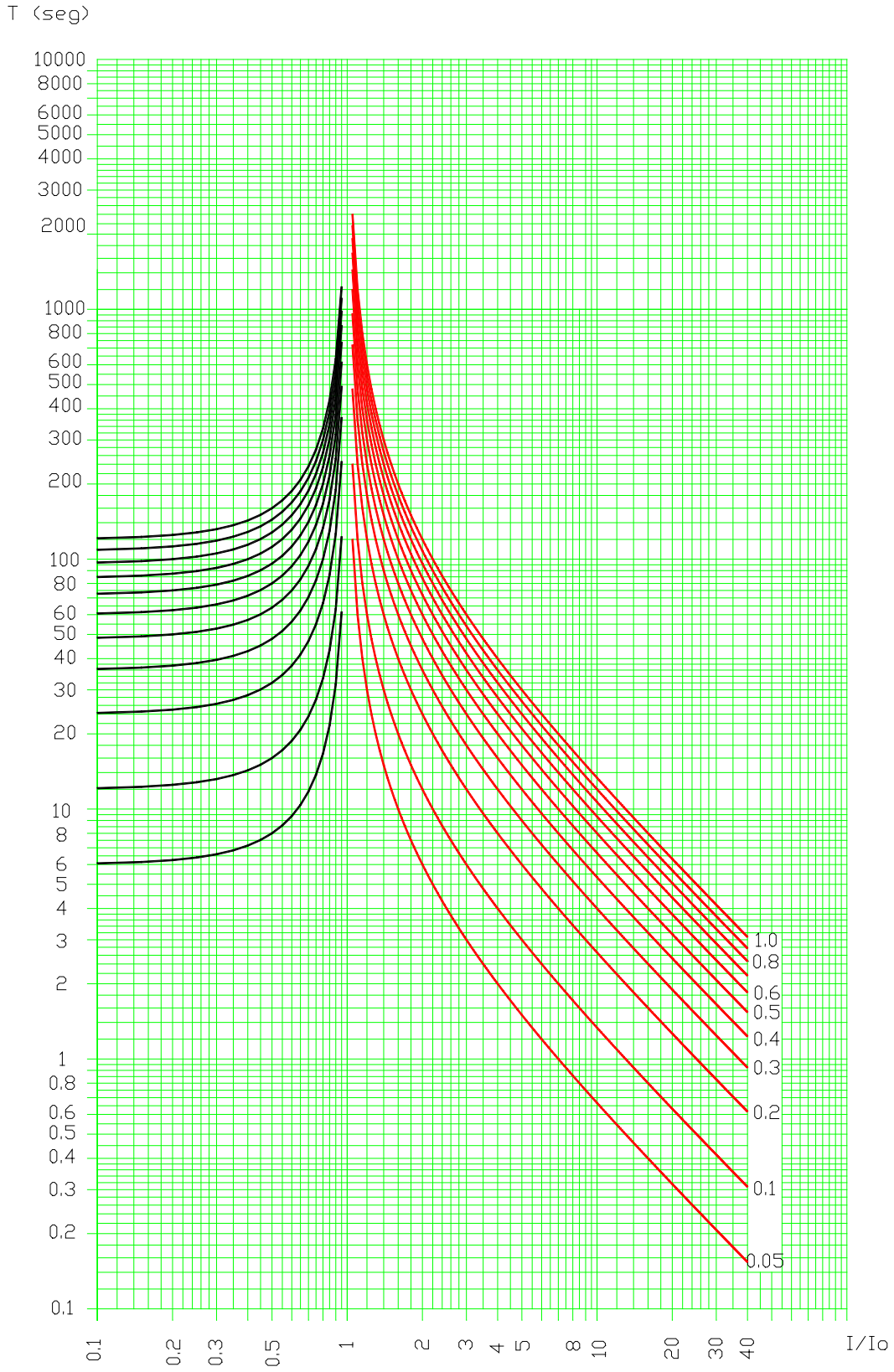
$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

K = 120, α = 1 **tr = 120**

Theoretical values given by the formula:

M I/Io	0	0.25	0.50	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.05	6.000	6.400	8.000	13.714	120.000	60.000	30.000	20.000	12.000	6.000	4.000	3.000	1.500	0.667	0.316	0.154
0.06	7.200	7.680	9.600	16.457	144.000	72.000	36.000	24.000	14.400	7.200	4.800	3.600	1.800	0.800	0.379	0.185
0.07	8.400	8.960	11.200	19.200	168.000	84.000	42.000	28.000	16.800	8.400	5.600	4.200	2.100	0.933	0.442	0.215
0.08	9.600	10.240	12.800	21.943	192.000	96.000	48.000	32.000	19.200	9.600	6.400	4.800	2.400	1.067	0.505	0.246
0.09	10.800	11.520	14.400	24.686	216.000	108.000	54.000	36.000	21.600	10.800	7.200	5.400	2.700	1.200	0.568	0.277
0.10	12.000	12.800	16.000	27.429	240.000	120.000	60.000	40.000	24.000	12.000	8.000	6.000	3.000	1.333	0.632	0.308
0.11	13.200	14.080	17.600	30.171	264.000	132.000	66.000	44.000	26.400	13.200	8.800	6.600	3.300	1.467	0.695	0.338
0.12	14.400	15.360	19.200	32.914	288.000	144.000	72.000	48.000	28.800	14.400	9.600	7.200	3.600	1.600	0.758	0.369
0.13	15.600	16.640	20.800	35.657	312.000	156.000	78.000	52.000	31.200	15.600	10.400	7.800	3.900	1.733	0.821	0.400
0.14	16.800	17.920	22.400	38.400	336.000	168.000	84.000	56.000	33.600	16.800	11.200	8.400	4.200	1.867	0.884	0.431
0.15	18.000	19.200	24.000	41.143	360.000	180.000	90.000	60.000	36.000	18.000	12.000	9.000	4.500	2.000	0.947	0.462
0.16	19.200	20.480	25.600	43.886	384.000	192.000	96.000	64.000	38.400	19.200	12.800	9.600	4.800	2.133	1.011	0.492
0.17	20.400	21.760	27.200	46.629	408.000	204.000	102.000	68.000	40.800	20.400	13.600	10.200	5.100	2.267	1.074	0.523
0.18	21.600	23.040	28.800	49.371	432.000	216.000	108.000	72.000	43.200	21.600	14.400	10.800	5.400	2.400	1.137	0.554
0.19	22.800	24.320	30.400	52.114	456.000	228.000	114.000	76.000	45.600	22.800	15.200	11.400	5.700	2.533	1.200	0.585
0.20	24.000	25.600	32.000	54.857	480.001	240.000	120.000	80.000	48.000	24.000	16.000	12.000	6.000	2.667	1.263	0.615
0.25	30.000	32.000	40.000	68.571	600.001	300.000	150.000	100.000	60.000	30.000	20.000	15.000	7.500	3.333	1.579	0.769
0.30	36.000	38.400	48.000	82.286	720.001	360.000	180.000	120.000	72.000	36.000	24.000	18.000	9.000	4.000	1.895	0.923
0.35	42.000	44.800	56.000	96.000	840.001	420.000	210.000	140.000	84.000	42.000	28.000	21.000	10.500	4.667	2.211	1.077
0.40	48.000	51.200	64.000	109.714	960.001	480.000	240.000	160.000	96.000	48.000	32.000	24.000	12.000	5.333	2.526	1.231
0.45	54.000	57.600	72.000	123.429	1080.001	540.000	270.000	180.000	108.000	54.000	36.000	27.000	13.500	6.000	2.842	1.385
0.50	60.000	64.000	80.000	137.143	1200.001	600.000	300.000	200.000	120.000	60.000	40.000	30.000	15.000	6.667	3.158	1.538
0.55	66.000	70.400	88.000	150.857	1320.001	660.000	330.000	220.000	132.000	66.000	44.000	33.000	16.500	7.333	3.474	1.692
0.60	72.000	76.800	96.000	164.571	1440.002	720.000	360.000	240.000	144.000	72.000	48.000	36.000	18.000	8.000	3.789	1.846
0.65	78.000	83.200	104.000	178.286	1560.002	780.000	390.000	260.000	156.000	78.000	52.000	39.000	19.500	8.667	4.105	2.000
0.70	84.000	89.600	112.000	192.000	1680.002	840.000	420.000	280.000	168.000	84.000	56.000	42.000	21.000	9.333	4.421	2.154
0.75	90.000	96.000	120.000	205.714	1800.002	900.000	450.000	300.000	180.000	90.000	60.000	45.000	22.500	10.000	4.737	2.308
0.80	96.000	102.400	128.000	219.429	1920.002	960.000	480.000	320.000	192.000	96.000	64.000	48.000	24.000	10.667	5.053	2.462
0.85	102.000	108.800	136.000	233.143	2040.002	1020.000	510.000	340.000	204.000	102.000	68.000	51.000	25.500	11.333	5.368	2.615
0.90	108.000	115.200	144.000	246.857	2160.002	1080.000	540.000	360.000	216.000	108.000	72.000	54.000	27.000	12.000	5.684	2.769
0.95	114.000	121.600	152.000	260.571	2280.003	1140.000	570.000	380.000	228.000	114.000	76.000	57.000	28.500	12.667	6.000	2.923
1.00	120.000	128.000	160.000	274.286	2400.003	1200.000	600.000	400.000	240.000	120.000	80.000	60.000	30.000	13.333	6.316	3.077
1.05	126.000	134.400	168.000	288.000	2520.003	1260.000	630.000	420.000	252.000	126.000	84.000	63.000	31.500	14.000	6.632	3.231



LONG DURATION INVERSE

Short duration curve IEC

$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

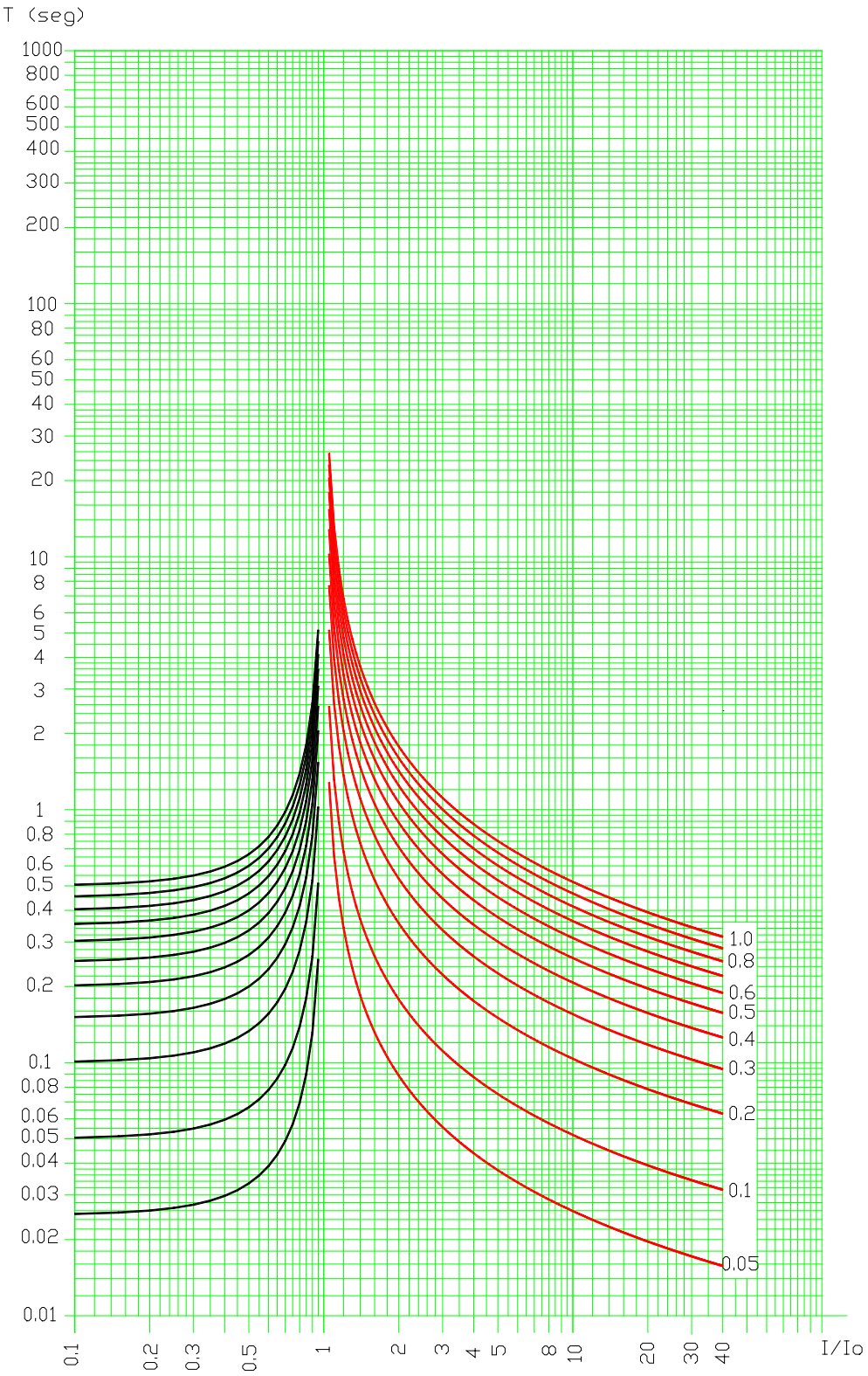
$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

K = 0.05, α = 0.04

tr = 0.5

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.05	0.025	0.027	0.033	0.057	1.280	0.655	0.342	0.237	0.153	0.089	0.067	0.056	0.038	0.026	0.020	0.016
0.06	0.030	0.032	0.040	0.069	1.536	0.785	0.410	0.284	0.183	0.107	0.080	0.067	0.045	0.031	0.024	0.019
0.07	0.035	0.037	0.047	0.080	1.792	0.916	0.478	0.332	0.214	0.124	0.094	0.078	0.053	0.036	0.027	0.022
0.08	0.040	0.043	0.053	0.091	2.048	1.047	0.546	0.379	0.245	0.142	0.107	0.089	0.060	0.041	0.031	0.025
0.09	0.045	0.048	0.060	0.103	2.304	1.178	0.615	0.427	0.275	0.160	0.121	0.100	0.068	0.047	0.035	0.028
0.10	0.050	0.053	0.067	0.114	2.559	1.309	0.683	0.474	0.306	0.178	0.134	0.111	0.075	0.052	0.039	0.031
0.11	0.055	0.059	0.073	0.126	2.815	1.440	0.751	0.521	0.336	0.196	0.147	0.122	0.083	0.057	0.043	0.035
0.12	0.060	0.064	0.080	0.137	3.071	1.571	0.820	0.569	0.367	0.213	0.161	0.134	0.090	0.062	0.047	0.038
0.13	0.065	0.069	0.087	0.149	3.327	1.702	0.888	0.616	0.398	0.231	0.174	0.145	0.098	0.067	0.051	0.041
0.14	0.070	0.075	0.093	0.160	3.583	1.833	0.956	0.664	0.428	0.249	0.188	0.156	0.105	0.073	0.055	0.044
0.15	0.075	0.080	0.100	0.171	3.839	1.964	1.025	0.711	0.459	0.267	0.201	0.167	0.113	0.078	0.059	0.047
0.16	0.080	0.085	0.107	0.183	4.095	2.094	1.093	0.758	0.489	0.285	0.214	0.178	0.120	0.083	0.063	0.050
0.17	0.085	0.091	0.113	0.194	4.351	2.225	1.161	0.806	0.520	0.302	0.228	0.189	0.128	0.088	0.067	0.053
0.18	0.090	0.096	0.120	0.206	4.607	2.356	1.230	0.853	0.550	0.320	0.241	0.200	0.135	0.093	0.071	0.057
0.19	0.095	0.101	0.127	0.217	4.863	2.487	1.298	0.900	0.581	0.338	0.254	0.211	0.143	0.098	0.075	0.060
0.20	0.100	0.107	0.133	0.229	5.119	2.618	1.366	0.948	0.612	0.356	0.268	0.223	0.150	0.104	0.079	0.063
0.25	0.125	0.133	0.167	0.286	6.399	3.273	1.708	1.185	0.764	0.445	0.335	0.278	0.188	0.130	0.098	0.079
0.30	0.150	0.160	0.200	0.343	7.678	3.927	2.049	1.422	0.917	0.534	0.402	0.334	0.226	0.155	0.118	0.094
0.35	0.175	0.187	0.233	0.400	8.958	4.582	2.391	1.659	1.070	0.622	0.469	0.390	0.263	0.181	0.137	0.110
0.40	0.200	0.213	0.267	0.457	10.238	5.236	2.732	1.896	1.223	0.711	0.536	0.445	0.301	0.207	0.157	0.126
0.45	0.225	0.240	0.300	0.514	11.518	5.891	3.074	2.133	1.376	0.800	0.603	0.501	0.338	0.233	0.177	0.142
0.50	0.250	0.267	0.333	0.571	12.797	6.545	3.416	2.370	1.529	0.889	0.670	0.556	0.376	0.259	0.196	0.157
0.55	0.275	0.293	0.367	0.629	14.077	7.200	3.757	2.607	1.682	0.978	0.737	0.612	0.414	0.285	0.216	0.173
0.60	0.300	0.320	0.400	0.686	15.357	7.854	4.099	2.844	1.835	1.067	0.804	0.668	0.451	0.311	0.236	0.189
0.65	0.325	0.347	0.433	0.743	16.637	8.509	4.440	3.081	1.988	1.156	0.871	0.723	0.489	0.337	0.255	0.204
0.70	0.350	0.373	0.467	0.800	17.916	9.163	4.782	3.318	2.141	1.245	0.938	0.779	0.526	0.363	0.275	0.220
0.75	0.375	0.400	0.500	0.857	19.196	9.818	5.123	3.555	2.293	1.334	1.005	0.835	0.564	0.389	0.295	0.236
0.80	0.400	0.427	0.533	0.914	20.476	10.472	5.465	3.792	2.446	1.423	1.071	0.890	0.602	0.415	0.314	0.252
0.85	0.425	0.453	0.567	0.971	21.756	11.127	5.806	4.029	2.599	1.512	1.138	0.946	0.639	0.441	0.334	0.267
0.90	0.450	0.480	0.600	1.029	23.035	11.781	6.148	4.265	2.752	1.601	1.205	1.002	0.677	0.466	0.353	0.283
0.95	0.475	0.507	0.633	1.086	24.315	12.436	6.489	4.502	2.905	1.690	1.272	1.057	0.714	0.492	0.373	0.299
1.00	0.500	0.533	0.667	1.143	25.595	13.090	6.831	4.739	3.058	1.778	1.339	1.113	0.752	0.518	0.393	0.314
1.05	0.525	0.560	0.700	1.200	26.875	13.745	7.173	4.976	3.211	1.867	1.406	1.169	0.790	0.544	0.412	0.330



SHORT DURATION INVERSE

Very inverse curve

$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

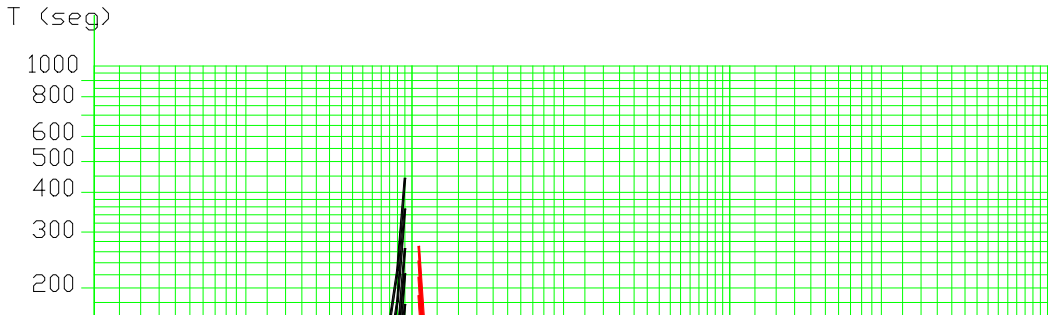
$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

K = 13,5, α = 1

tr = 43.2

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.05	2.160	2.304	2.880	4.937	13.500	6.750	3.375	2.250	1.350	0.675	0.450	0.338	0.169	0.075	0.036	0.017
0.06	2.592	2.765	3.456	5.925	16.200	8.100	4.050	2.700	1.620	0.810	0.540	0.405	0.203	0.090	0.043	0.021
0.07	3.024	3.226	4.032	6.912	18.900	9.450	4.725	3.150	1.890	0.945	0.630	0.472	0.236	0.105	0.050	0.024
0.08	3.456	3.686	4.608	7.899	21.600	10.800	5.400	3.600	2.160	1.080	0.720	0.540	0.270	0.120	0.057	0.028
0.09	3.888	4.147	5.184	8.887	24.300	12.150	6.075	4.050	2.430	1.215	0.810	0.607	0.304	0.135	0.064	0.031
0.10	4.320	4.608	5.760	9.874	27.000	13.500	6.750	4.500	2.700	1.350	0.900	0.675	0.337	0.150	0.071	0.035
0.11	4.752	5.069	6.336	10.862	29.700	14.850	7.425	4.950	2.970	1.485	0.990	0.742	0.371	0.165	0.078	0.038
0.12	5.184	5.530	6.912	11.849	32.400	16.200	8.100	5.400	3.240	1.620	1.080	0.810	0.405	0.180	0.085	0.042
0.13	5.616	5.990	7.488	12.837	35.100	17.550	8.775	5.850	3.510	1.755	1.170	0.877	0.439	0.195	0.092	0.045
0.14	6.048	6.451	8.064	13.824	37.800	18.900	9.450	6.300	3.780	1.890	1.260	0.945	0.472	0.210	0.099	0.048
0.15	6.480	6.912	8.640	14.811	40.500	20.250	10.125	6.750	4.050	2.025	1.350	1.013	0.506	0.225	0.107	0.052
0.16	6.912	7.373	9.216	15.799	43.200	21.600	10.800	7.200	4.320	2.160	1.440	1.080	0.540	0.240	0.114	0.055
0.17	7.344	7.834	9.792	16.786	45.900	22.950	11.475	7.650	4.590	2.295	1.530	1.148	0.574	0.255	0.121	0.059
0.18	7.776	8.294	10.368	17.774	48.600	24.300	12.150	8.100	4.860	2.430	1.620	1.215	0.608	0.270	0.128	0.062
0.19	8.208	8.755	10.944	18.761	51.300	25.650	12.825	8.550	5.130	2.565	1.710	1.283	0.641	0.285	0.135	0.066
0.20	8.640	9.216	11.520	19.749	54.000	27.000	13.500	9.000	5.400	2.700	1.800	1.350	0.675	0.300	0.142	0.069
0.25	10.800	11.520	14.400	24.686	67.500	33.750	16.875	11.250	6.750	3.375	2.250	1.688	0.844	0.375	0.178	0.087
0.30	12.960	13.824	17.280	29.623	81.000	40.500	20.250	13.500	8.100	4.050	2.700	2.025	1.013	0.450	0.213	0.104
0.35	15.120	16.128	20.160	34.560	94.500	47.250	23.625	15.750	9.450	4.725	3.150	2.363	1.181	0.525	0.249	0.121
0.40	17.280	18.432	23.040	39.497	108.000	54.000	27.000	18.000	10.800	5.400	3.600	2.700	1.350	0.600	0.284	0.138
0.45	19.440	20.736	25.920	44.434	121.500	60.750	30.375	20.250	12.150	6.075	4.050	3.038	1.519	0.675	0.320	0.156
0.50	21.600	23.040	28.800	49.371	135.000	67.500	33.750	22.500	13.500	6.750	4.500	3.375	1.688	0.750	0.355	0.173
0.55	23.760	25.344	31.680	54.309	148.500	74.250	37.125	24.750	14.850	7.425	4.950	3.713	1.856	0.825	0.391	0.190
0.60	25.920	27.648	34.560	59.246	162.000	81.000	40.500	27.000	16.200	8.100	5.400	4.050	2.025	0.900	0.426	0.208
0.65	28.080	29.952	37.440	64.183	175.500	87.750	43.875	29.250	17.550	8.775	5.850	4.388	2.194	0.975	0.462	0.225
0.70	30.240	32.256	40.320	69.120	189.000	94.500	47.250	31.500	18.900	9.450	6.300	4.725	2.363	1.050	0.497	0.242
0.75	32.400	34.560	43.200	74.057	202.500	101.25	50.625	33.750	20.250	10.125	6.750	5.063	2.531	1.125	0.533	0.260
0.80	34.560	36.864	46.080	78.994	216.000	108.00	54.000	36.000	21.600	10.800	7.200	5.400	2.700	1.200	0.568	0.277
0.85	36.720	39.168	48.960	83.931	229.500	114.75	57.375	38.250	22.950	11.475	7.650	5.738	2.869	1.275	0.604	0.294
0.90	38.880	41.472	51.840	88.869	243.000	121.50	60.750	40.500	24.300	12.150	8.100	6.075	3.038	1.350	0.639	0.312
0.95	41.040	43.776	54.720	93.806	256.500	128.25	64.125	42.750	25.650	12.825	8.550	6.413	3.206	1.425	0.675	0.329
1.00	43.200	46.080	57.600	98.743	270.000	135.00	67.500	45.000	27.000	13.500	9.000	6.750	3.375	1.500	0.711	0.346
1.05	45.360	48.384	60.480	103.68	283.500	141.75	70.875	47.250	28.350	14.175	9.450	7.088	3.544	1.575	0.746	0.363



Extremely inverse curve

$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

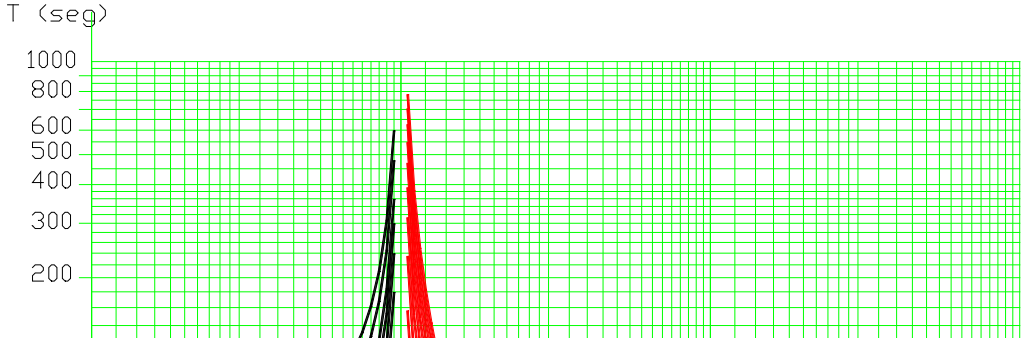
$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

K = 80, α = 2

tr =58.2

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.05	2.910	3.104	3.880	6.651	39.024	19.048	9.091	5.797	3.200	1.333	0.762	0.500	0.167	0.040	0.010	0.003
0.06	3.492	3.725	4.656	7.982	46.829	22.857	10.909	6.957	3.840	1.600	0.914	0.600	0.200	0.048	0.012	0.003
0.07	4.074	4.346	5.432	9.312	54.634	26.667	12.727	8.116	4.480	1.867	1.067	0.700	0.233	0.057	0.014	0.004
0.08	4.656	4.966	6.208	10.642	62.439	30.476	14.545	9.275	5.120	2.133	1.219	0.800	0.267	0.065	0.016	0.004
0.09	5.238	5.587	6.984	11.973	70.244	34.286	16.364	10.435	5.760	2.400	1.371	0.900	0.300	0.073	0.018	0.005
0.10	5.820	6.208	7.760	13.303	78.049	38.095	18.182	11.594	6.400	2.667	1.524	1.000	0.333	0.081	0.020	0.005
0.11	6.402	6.829	8.536	14.633	85.854	41.905	20.000	12.754	7.040	2.933	1.676	1.100	0.367	0.089	0.022	0.006
0.12	6.984	7.450	9.312	15.963	93.659	45.714	21.818	13.913	7.680	3.200	1.829	1.200	0.400	0.097	0.024	0.006
0.13	7.566	8.070	10.088	17.294	101.464	49.524	23.636	15.072	8.320	3.467	1.981	1.300	0.433	0.105	0.026	0.007
0.14	8.148	8.691	10.864	18.624	109.268	53.333	25.455	16.232	8.960	3.733	2.133	1.400	0.467	0.113	0.028	0.007
0.15	8.730	9.312	11.640	19.954	117.073	57.143	27.273	17.391	9.600	4.000	2.286	1.500	0.500	0.121	0.030	0.008
0.16	9.312	9.933	12.416	21.285	124.878	60.952	29.091	18.551	10.240	4.267	2.438	1.600	0.533	0.129	0.032	0.008
0.17	9.894	10.554	13.192	22.615	132.683	64.762	30.909	19.710	10.880	4.533	2.590	1.700	0.567	0.137	0.034	0.009
0.18	10.476	11.174	13.968	23.945	140.488	68.571	32.727	20.870	11.520	4.800	2.743	1.800	0.600	0.145	0.036	0.009
0.19	11.058	11.795	14.744	25.275	148.293	72.381	34.545	22.029	12.160	5.067	2.895	1.900	0.633	0.154	0.038	0.010
0.20	11.640	12.416	15.520	26.606	156.098	76.190	36.364	23.188	12.800	5.333	3.048	2.000	0.667	0.162	0.040	0.010
0.25	14.550	15.520	19.400	33.257	195.122	95.238	45.455	28.986	16.000	6.667	3.810	2.500	0.833	0.202	0.050	0.013
0.30	17.460	18.624	23.280	39.909	234.147	114.286	54.545	34.783	19.200	8.000	4.571	3.000	1.000	0.242	0.060	0.015
0.35	20.370	21.728	27.160	46.560	273.171	133.333	63.636	40.580	22.400	9.333	5.333	3.500	1.167	0.283	0.070	0.018
0.40	23.280	24.832	31.040	53.211	312.195	152.381	72.727	46.377	25.600	10.667	6.095	4.000	1.333	0.323	0.080	0.020
0.45	26.190	27.936	34.920	59.863	351.220	171.429	81.818	52.174	28.800	12.000	6.857	4.500	1.500	0.364	0.090	0.023
0.50	29.100	31.040	38.800	66.514	390.244	190.476	90.909	57.971	32.000	13.333	7.619	5.000	1.667	0.404	0.100	0.025
0.55	32.010	34.144	42.680	73.166	429.269	209.524	100.000	63.768	35.200	14.667	8.381	5.500	1.833	0.444	0.110	0.028
0.60	34.920	37.248	46.560	79.817	468.293	228.571	109.091	69.565	38.400	16.000	9.143	6.000	2.000	0.485	0.120	0.030
0.65	37.830	40.352	50.440	86.469	507.318	247.619	118.182	75.362	41.600	17.333	9.905	6.500	2.167	0.525	0.130	0.033
0.70	40.740	43.456	54.320	93.120	546.342	266.667	127.273	81.159	44.800	18.667	10.667	7.000	2.333	0.566	0.140	0.035
0.75	43.650	46.560	58.200	99.771	585.367	285.714	136.364	86.957	48.000	20.000	11.429	7.500	2.500	0.606	0.150	0.038
0.80	46.560	49.664	62.080	106.423	624.391	304.762	145.455	92.754	51.200	21.333	12.190	8.000	2.667	0.646	0.160	0.040
0.85	49.470	52.768	65.960	113.074	663.415	323.810	154.545	98.551	54.400	22.667	12.952	8.500	2.833	0.687	0.170	0.043
0.90	52.380	55.872	69.840	119.726	702.440	342.857	163.636	104.348	57.600	24.000	13.714	9.000	3.000	0.727	0.180	0.045
0.95	55.290	58.976	73.720	126.377	741.464	361.905	172.727	110.145	60.800	25.333	14.476	9.500	3.167	0.768	0.190	0.048
1.00	58.200	62.080	77.600	133.029	780.489	380.952	181.818	115.942	64.000	26.667	15.238	10.000	3.333	0.808	0.201	0.050
1.05	61.110	65.184	81.480	139.680	819.513	400.000	190.909	121.739	67.200	28.000	16.000	10.500	3.500	0.848	0.211	0.053



Special very inverse curve

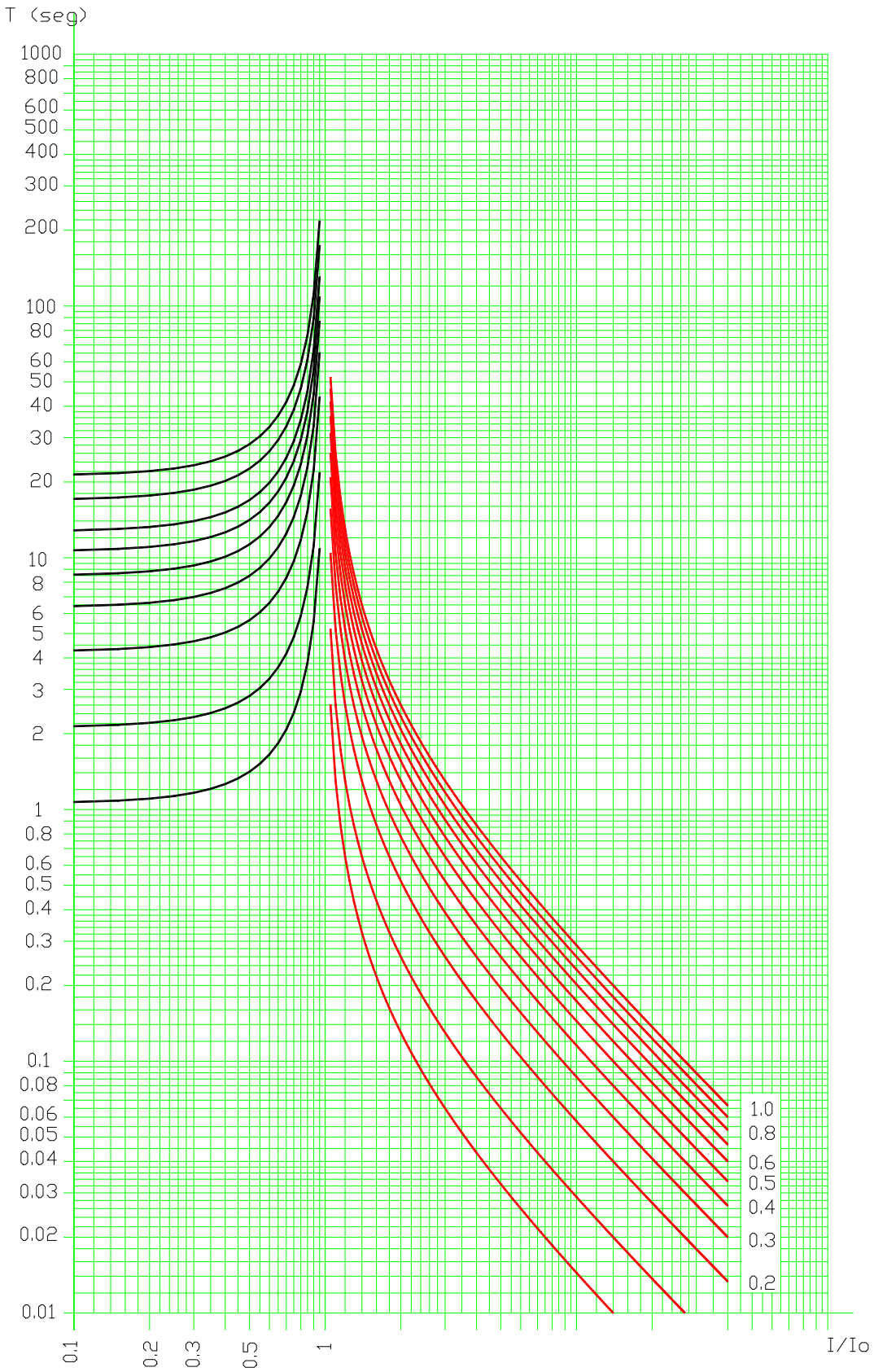
$$T := M \cdot \frac{k}{\left(\frac{I}{I_0}\right)^{\alpha} - 1}$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^{2} - 1}$$

K = 2,6 α = 1

Theoretical values given by the formula:

M I/Io	1.05	1.10	1.20	1.30	1.40	1.50	2.00	2.50	3.00	4.00	5.00	7.00	10.00	12.00	15.00	20.00	30.00	40.00
0.05	2.600	1.300	0.650	0.433	0.325	0.260	0.130	0.087	0.065	0.043	0.032	0.022	0.014	0.012	0.009	0.007	0.004	0.003
0.06	3.120	1.560	0.780	0.520	0.390	0.312	0.156	0.104	0.078	0.052	0.039	0.026	0.017	0.014	0.011	0.008	0.005	0.004
0.07	3.640	1.820	0.910	0.607	0.455	0.364	0.182	0.121	0.091	0.061	0.045	0.030	0.020	0.017	0.013	0.010	0.006	0.005
0.08	4.160	2.080	1.040	0.693	0.520	0.416	0.208	0.139	0.104	0.069	0.052	0.035	0.023	0.019	0.015	0.011	0.007	0.005
0.09	4.680	2.340	1.170	0.780	0.585	0.468	0.234	0.156	0.117	0.078	0.058	0.039	0.026	0.021	0.017	0.012	0.008	0.006
0.10	5.200	2.600	1.300	0.867	0.650	0.520	0.260	0.173	0.130	0.087	0.065	0.043	0.029	0.024	0.019	0.014	0.009	0.007
0.11	5.720	2.860	1.430	0.953	0.715	0.572	0.286	0.191	0.143	0.095	0.071	0.048	0.032	0.026	0.020	0.015	0.010	0.007
0.12	6.240	3.120	1.560	1.040	0.780	0.624	0.312	0.208	0.156	0.104	0.078	0.052	0.035	0.028	0.022	0.016	0.011	0.008
0.13	6.760	3.380	1.690	1.127	0.845	0.676	0.338	0.225	0.169	0.113	0.084	0.056	0.038	0.031	0.024	0.018	0.012	0.009
0.14	7.280	3.640	1.820	1.213	0.910	0.728	0.364	0.243	0.182	0.121	0.091	0.061	0.040	0.033	0.026	0.019	0.013	0.009
0.15	7.800	3.900	1.950	1.300	0.975	0.780	0.390	0.260	0.195	0.130	0.098	0.065	0.043	0.035	0.028	0.021	0.013	0.010
0.16	8.320	4.160	2.080	1.387	1.040	0.832	0.416	0.277	0.208	0.139	0.104	0.069	0.046	0.038	0.030	0.022	0.014	0.011
0.17	8.840	4.420	2.210	1.473	1.105	0.884	0.442	0.295	0.221	0.147	0.111	0.074	0.049	0.040	0.032	0.023	0.015	0.011
0.18	9.360	4.680	2.340	1.560	1.170	0.936	0.468	0.312	0.234	0.156	0.117	0.078	0.052	0.043	0.033	0.025	0.016	0.012
0.19	9.880	4.940	2.470	1.647	1.235	0.988	0.494	0.329	0.247	0.165	0.124	0.082	0.055	0.045	0.035	0.026	0.017	0.013
0.20	10.400	5.200	2.600	1.733	1.300	1.040	0.520	0.347	0.260	0.173	0.130	0.087	0.058	0.047	0.037	0.027	0.018	0.013
0.25	13.000	6.500	3.250	2.167	1.625	1.300	0.650	0.433	0.325	0.217	0.163	0.108	0.072	0.059	0.046	0.034	0.022	0.017
0.30	15.600	7.800	3.900	2.600	1.950	1.560	0.780	0.520	0.390	0.260	0.195	0.130	0.087	0.071	0.056	0.041	0.027	0.020
0.35	18.200	9.100	4.550	3.033	2.275	1.820	0.910	0.607	0.455	0.303	0.228	0.152	0.101	0.083	0.065	0.048	0.031	0.023
0.40	20.800	10.400	5.200	3.467	2.600	2.080	1.040	0.693	0.520	0.347	0.260	0.173	0.116	0.095	0.074	0.055	0.036	0.027
0.45	23.400	11.700	5.850	3.900	2.925	2.340	1.170	0.780	0.585	0.390	0.293	0.195	0.130	0.106	0.084	0.062	0.040	0.030
0.50	26.000	13.000	6.500	4.333	3.250	2.600	1.300	0.867	0.650	0.433	0.325	0.217	0.144	0.118	0.093	0.068	0.045	0.033
0.55	28.600	14.300	7.150	4.767	3.575	2.860	1.430	0.953	0.715	0.477	0.358	0.238	0.159	0.130	0.102	0.075	0.049	0.037
0.60	31.200	15.600	7.800	5.200	3.900	3.120	1.560	1.040	0.780	0.520	0.390	0.260	0.173	0.142	0.111	0.082	0.054	0.040
0.65	33.800	16.900	8.450	5.633	4.225	3.380	1.690	1.127	0.845	0.563	0.423	0.282	0.188	0.154	0.121	0.089	0.058	0.043
0.70	36.400	18.200	9.100	6.067	4.550	3.640	1.820	1.213	0.910	0.607	0.455	0.303	0.202	0.165	0.130	0.096	0.063	0.047
0.75	39.000	19.500	9.750	6.500	4.875	3.900	1.950	1.300	0.975	0.650	0.488	0.325	0.217	0.177	0.139	0.103	0.067	0.050
0.80	41.600	20.800	10.400	6.933	5.200	4.160	2.080	1.387	1.040	0.693	0.520	0.347	0.231	0.189	0.149	0.109	0.072	0.053
0.85	44.200	22.100	11.050	7.367	5.525	4.420	2.210	1.473	1.105	0.737	0.553	0.368	0.246	0.201	0.158	0.116	0.076	0.057
0.90	46.800	23.400	11.700	7.800	5.850	4.680	2.340	1.560	1.170	0.780	0.585	0.390	0.260	0.213	0.167	0.123	0.081	0.060
0.95	49.400	24.700	12.350	8.233	6.175	4.940	2.470	1.647	1.235	0.823	0.618	0.412	0.274	0.225	0.176	0.130	0.085	0.063
1.00	52.000	26.000	13.000	8.667	6.500	5.200	2.600	1.733	1.300	0.867	0.650	0.433	0.289	0.236	0.186	0.137	0.090	0.067
1.05	54.600	27.300	13.650	9.100	6.825	5.460	2.730	1.820	1.365	0.910	0.683	0.455	0.303	0.248	0.195	0.144	0.094	0.070



IX.2. CUI

Enclosed belc

Normal In

Very Inver

Extremely

Moderatel

These curves

$$T := M \cdot \left[A \right.$$

T : Trip time

T_{drop} : drop tir...

M : multiplier ("time index"). Valid range from 0.5 to 30.0 in 0.1 steps

VERY INVERSE SPECIAL CURVE

I: Measured current

Io: Pickup current setting

A,B,C,D,E tr, constants that depend upon the type of curve:

Constants	Inverse charact.	Very inverse	Extrem. inverse	Moderat. inverse
A	0.0274	0.0615	0.0399	0.1735
B	2.2614	0.7989	0.2294	0.6791
C	0.3000	0.3400	0.5000	0.8000
D	-4.1899	-0.2840	3.0094	-0.0800
E	9.1272	4.0505	0.7222	0.1271
tr	0.99	4.678	6.008	1.2

Below, the corresponding curve for the indexes 0.5, 1.0, 2.0, 3.0, 4.0, 6.0, 8.0, 10.0, 15.0, 20.0 and 30.0 are represented for every characteristic type. Take into account that between every two curves differentiated in 1.0 there are other 9 curves.

Inverse normal curve

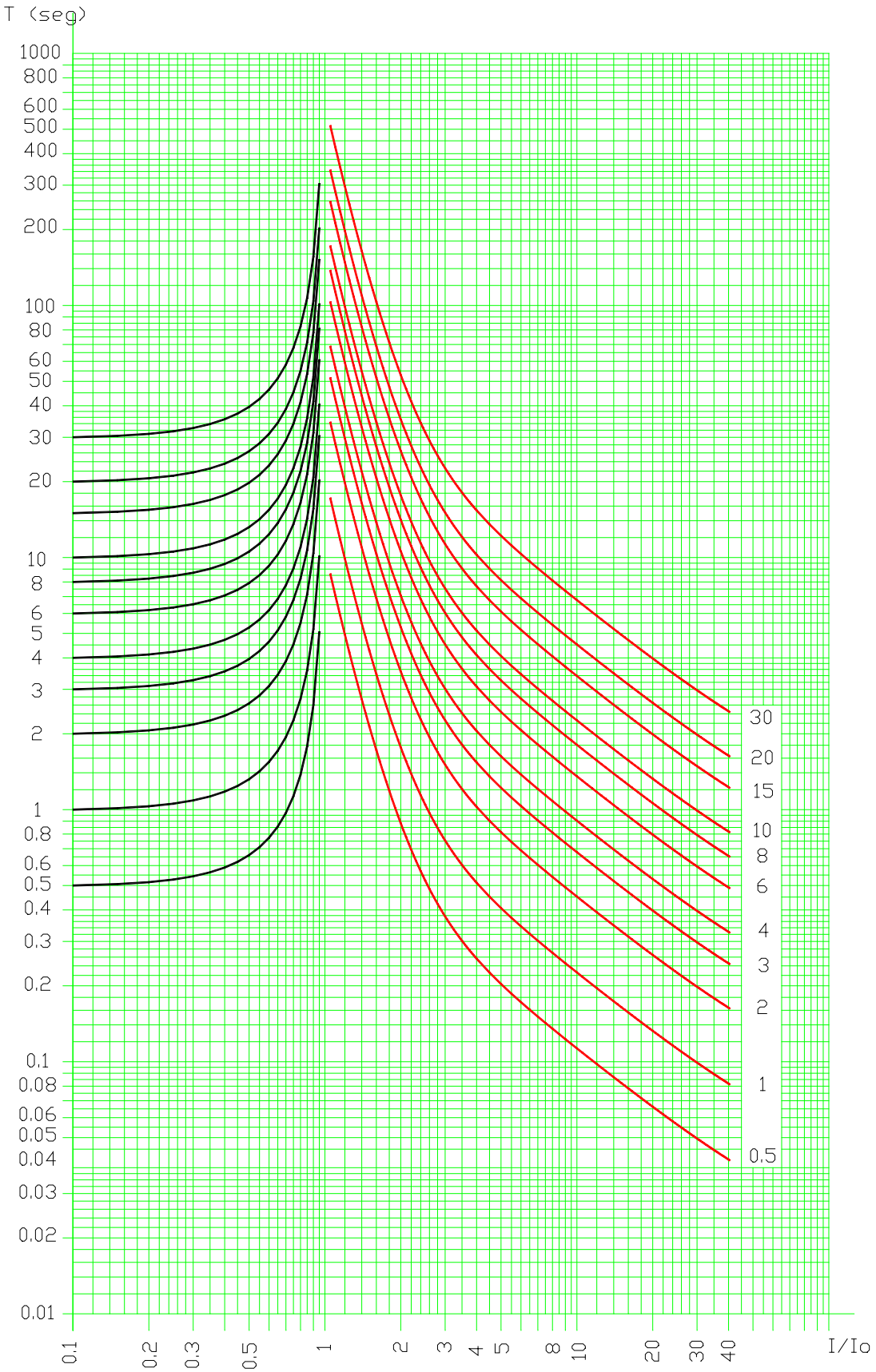
$$T := M \cdot \left[A + \frac{B}{\left(\frac{I}{I_0} - C\right)} + \frac{D}{\left(\frac{I}{I_0} - C\right)^2} + \frac{E}{\left(\frac{I}{I_0} - C\right)^3} \right]$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^2 - 1}$$

A = 0.0274, B = 2.2614, C = 0.3000, D = -4.1899, E = 9.1272 tr = 0.99

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.5	0.495	0.528	0.660	1.131	8.614	7.067	4.944	3.613	2.142	0.883	0.523	0.377	0.203	0.113	0.066	0.041
1.0	0.990	1.056	1.320	2.263	17.229	14.134	9.888	7.226	4.284	1.766	1.047	0.754	0.407	0.226	0.133	0.082
2.0	1.980	2.112	2.640	4.526	34.457	28.268	19.775	14.452	8.568	3.531	2.094	1.508	0.814	0.452	0.265	0.164
3.0	2.970	3.168	3.960	6.789	51.686	42.402	29.663	21.678	12.853	5.297	3.140	2.262	1.220	0.678	0.398	0.246
4.0	3.960	4.224	5.280	9.051	68.915	56.536	39.550	28.904	17.137	7.062	4.187	3.016	1.627	0.904	0.530	0.327
5.0	4.950	5.280	6.600	11.314	86.144	70.670	49.438	36.131	21.421	8.828	5.234	3.770	2.034	1.130	0.663	0.409
6.0	5.940	6.336	7.920	13.577	103.372	84.804	59.325	43.357	25.705	10.594	6.281	4.524	2.441	1.356	0.796	0.491
7.0	6.930	7.392	9.240	15.840	120.601	98.938	69.213	50.583	29.989	12.359	7.328	5.277	2.848	1.582	0.928	0.573
8.0	7.920	8.448	10.560	18.103	137.830	113.072	79.100	57.809	34.274	14.125	8.374	6.031	3.254	1.808	1.061	0.655
9.0	8.910	9.504	11.880	20.366	155.059	127.206	88.988	65.035	38.558	15.890	9.421	6.785	3.661	2.034	1.193	0.737
10.0	9.900	10.560	13.200	22.629	172.287	141.340	98.875	72.261	42.842	17.656	10.468	7.539	4.068	2.260	1.326	0.818
11.0	10.890	11.616	14.520	24.891	189.516	155.474	108.763	79.487	47.126	19.422	11.515	8.293	4.475	2.486	1.458	0.900
12.0	11.880	12.672	15.840	27.154	206.745	169.608	118.650	86.713	51.410	21.187	12.562	9.047	4.881	2.712	1.591	0.982
13.0	12.870	13.728	17.160	29.417	223.974	183.742	128.538	93.939	55.694	22.953	13.608	9.801	5.288	2.938	1.724	1.064
14.0	13.860	14.784	18.480	31.680	241.202	197.876	138.425	101.165	59.979	24.719	14.655	10.555	5.695	3.164	1.856	1.146
15.0	14.850	15.840	19.800	33.943	258.431	212.010	148.313	108.392	64.263	26.484	15.702	11.309	6.102	3.390	1.989	1.228
16.0	15.840	16.896	21.120	36.206	275.660	226.144	158.200	115.618	68.547	28.250	16.749	12.063	6.509	3.616	2.121	1.310
17.0	16.830	17.952	22.440	38.469	292.889	240.278	168.088	122.844	72.831	30.015	17.796	12.817	6.915	3.842	2.254	1.391
18.0	17.820	19.008	23.760	40.731	310.117	254.412	177.975	130.070	77.115	31.781	18.842	13.571	7.322	4.068	2.387	1.473
19.0	18.810	20.064	25.080	42.994	327.346	268.546	187.863	137.296	81.400	33.547	19.889	14.324	7.729	4.294	2.519	1.555
20.0	19.800	21.120	26.400	45.257	344.575	282.680	197.750	144.522	85.684	35.312	20.936	15.078	8.136	4.520	2.652	1.637
21.0	20.790	22.176	27.720	47.520	361.803	296.814	207.638	151.748	89.968	37.078	21.983	15.832	8.543	4.746	2.784	1.719
22.0	21.780	23.232	29.040	49.783	379.032	310.948	217.525	158.974	94.252	38.843	23.030	16.586	8.949	4.972	2.917	1.801
23.0	22.770	24.288	30.360	52.046	396.261	325.082	227.413	166.200	98.536	40.609	24.076	17.340	9.356	5.198	3.050	1.883
24.0	23.760	25.344	31.680	54.309	413.490	339.216	237.300	173.426	102.821	42.375	25.123	18.094	9.763	5.424	3.182	1.964
25.0	24.750	26.400	33.000	56.571	430.718	353.350	247.188	180.653	107.105	44.140	26.170	18.848	10.170	5.650	3.315	2.046
26.0	25.740	27.456	34.320	58.834	447.947	367.484	257.075	187.879	111.389	45.906	27.217	19.602	10.576	5.876	3.447	2.128
27.0	26.730	28.512	35.640	61.097	465.176	381.618	266.963	195.105	115.673	47.671	28.264	20.356	10.983	6.102	3.580	2.210
28.0	27.720	29.568	36.960	63.360	482.405	395.752	276.850	202.331	119.957	49.437	29.310	21.110	11.390	6.328	3.713	2.292
29.0	28.710	30.624	38.280	65.623	499.633	409.886	286.738	209.557	124.242	51.203	30.357	21.864	11.797	6.554	3.845	2.374
30.0	29.700	31.680	39.600	67.886	516.862	424.020	296.625	216.783	128.526	52.968	31.404	22.618	12.204	6.780	3.978	2.455



INVERSE CURVE

Very inverse curve

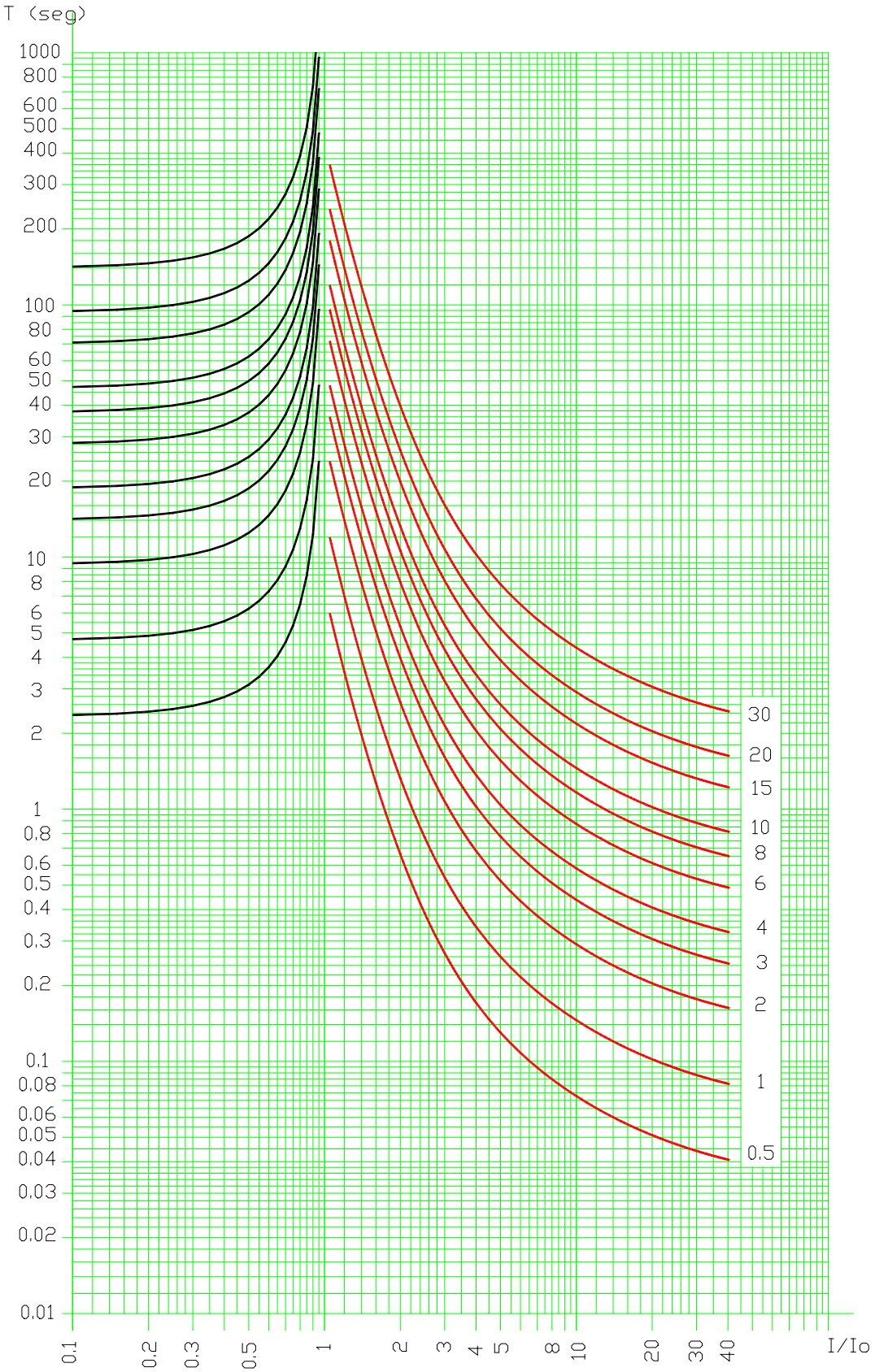
$$T := M \cdot \left[A + \frac{B}{\left(\frac{I}{I_0} - C\right)} + \frac{D}{\left(\frac{I}{I_0} - C\right)^2} + \frac{E}{\left(\frac{I}{I_0} - C\right)^3} \right]$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^2 - 1}$$

A = 0.0615, B = 0.7989, C = 0.3400, D = -0.2840, E = 4.0505 tr = 4.678

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.5	2.339	2.495	3.119	5.346	5.970	4.924	3.487	2.582	1.567	0.663	0.386	0.268	0.130	0.073	0.051	0.041
1.0	4.678	4.990	6.237	10.693	11.940	9.848	6.975	5.164	3.134	1.325	0.772	0.537	0.260	0.146	0.102	0.082
2.0	9.356	9.980	12.475	21.385	23.881	19.696	13.949	10.327	6.268	2.650	1.545	1.074	0.520	0.291	0.204	0.163
3.0	14.034	14.970	18.712	32.078	35.821	29.544	20.924	15.491	9.402	3.976	2.317	1.611	0.780	0.437	0.306	0.245
4.0	18.712	19.959	24.949	42.770	47.762	39.393	27.898	20.655	12.537	5.301	3.090	2.148	1.040	0.583	0.408	0.326
5.0	23.390	24.949	31.187	53.463	59.702	49.241	34.873	25.819	15.671	6.626	3.862	2.685	1.299	0.728	0.510	0.408
6.0	28.068	29.939	37.424	64.155	71.642	59.089	41.848	30.982	18.805	7.951	4.635	3.221	1.559	0.874	0.612	0.489
7.0	32.746	34.929	43.661	74.848	83.583	68.937	48.822	36.146	21.939	9.276	5.407	3.758	1.819	1.020	0.714	0.571
8.0	37.424	39.919	49.899	85.541	95.523	78.785	55.797	41.310	25.073	10.602	6.179	4.295	2.079	1.165	0.815	0.652
9.0	42.102	44.909	56.136	96.233	107.464	88.633	62.771	46.474	28.207	11.927	6.952	4.832	2.339	1.311	0.917	0.734
10.0	46.780	49.899	62.373	106.926	119.404	98.481	69.746	51.637	31.341	13.252	7.724	5.369	2.599	1.457	1.019	0.815
11.0	51.458	54.889	68.611	117.618	131.344	108.330	76.721	56.801	34.475	14.577	8.497	5.906	2.859	1.602	1.121	0.897
12.0	56.136	59.878	74.848	128.311	143.285	118.178	83.695	61.965	37.610	15.902	9.269	6.443	3.119	1.748	1.223	0.978
13.0	60.814	64.868	81.085	139.003	155.225	128.026	90.670	67.128	40.744	17.228	10.041	6.980	3.379	1.893	1.325	1.060
14.0	65.492	69.858	87.323	149.696	167.165	137.874	97.645	72.292	43.878	18.553	10.814	7.517	3.638	2.039	1.427	1.141
15.0	70.170	74.848	93.560	160.389	179.106	147.722	104.619	77.456	47.012	19.878	11.586	8.054	3.898	2.185	1.529	1.223
16.0	74.848	79.838	99.797	171.081	191.046	157.570	111.594	82.620	50.146	21.203	12.359	8.591	4.158	2.330	1.631	1.304
17.0	79.526	84.828	106.035	181.774	202.987	167.419	118.568	87.783	53.280	22.528	13.131	9.127	4.418	2.476	1.733	1.386
18.0	84.204	89.818	112.272	192.466	214.927	177.267	125.543	92.947	56.414	23.853	13.904	9.664	4.678	2.622	1.835	1.468
19.0	88.882	94.807	118.509	203.159	226.867	187.115	132.518	98.111	59.549	25.179	14.676	10.201	4.938	2.767	1.937	1.549
20.0	93.560	99.797	124.747	213.851	238.808	196.963	139.492	103.275	62.683	26.504	15.448	10.738	5.198	2.913	2.039	1.631
21.0	98.238	104.787	130.984	224.544	250.748	206.811	146.467	108.438	65.817	27.829	16.221	11.275	5.458	3.059	2.141	1.712
22.0	102.916	109.777	137.221	235.237	262.689	216.659	153.441	113.602	68.951	29.154	16.993	11.812	5.718	3.204	2.243	1.794
23.0	107.594	114.767	143.459	245.929	274.629	226.507	160.416	118.766	72.085	30.479	17.766	12.349	5.977	3.350	2.344	1.875
24.0	112.272	119.757	149.696	256.622	286.569	236.356	167.391	123.930	75.219	31.805	18.538	12.886	6.237	3.496	2.446	1.957
25.0	116.950	124.747	155.933	267.314	298.510	246.204	174.365	129.093	78.353	33.130	19.310	13.423	6.497	3.641	2.548	2.038
26.0	121.628	129.737	162.171	278.007	310.450	256.052	181.340	134.257	81.487	34.455	20.083	13.960	6.757	3.787	2.650	2.120
27.0	126.306	134.726	168.408	288.699	322.391	265.900	188.314	139.421	84.622	35.780	20.855	14.497	7.017	3.933	2.752	2.201
28.0	130.984	139.716	174.645	299.392	334.331	275.748	195.289	144.584	87.756	37.105	21.628	15.034	7.277	4.078	2.854	2.283
29.0	135.662	144.706	180.883	310.085	346.271	285.596	202.264	149.748	90.890	38.431	22.400	15.570	7.537	4.224	2.956	2.364
30.0	140.340	149.696	187.120	320.777	358.212	295.444	209.238	154.912	94.024	39.756	23.173	16.107	7.797	4.370	3.058	2.446



VERY INVERSE CURVE

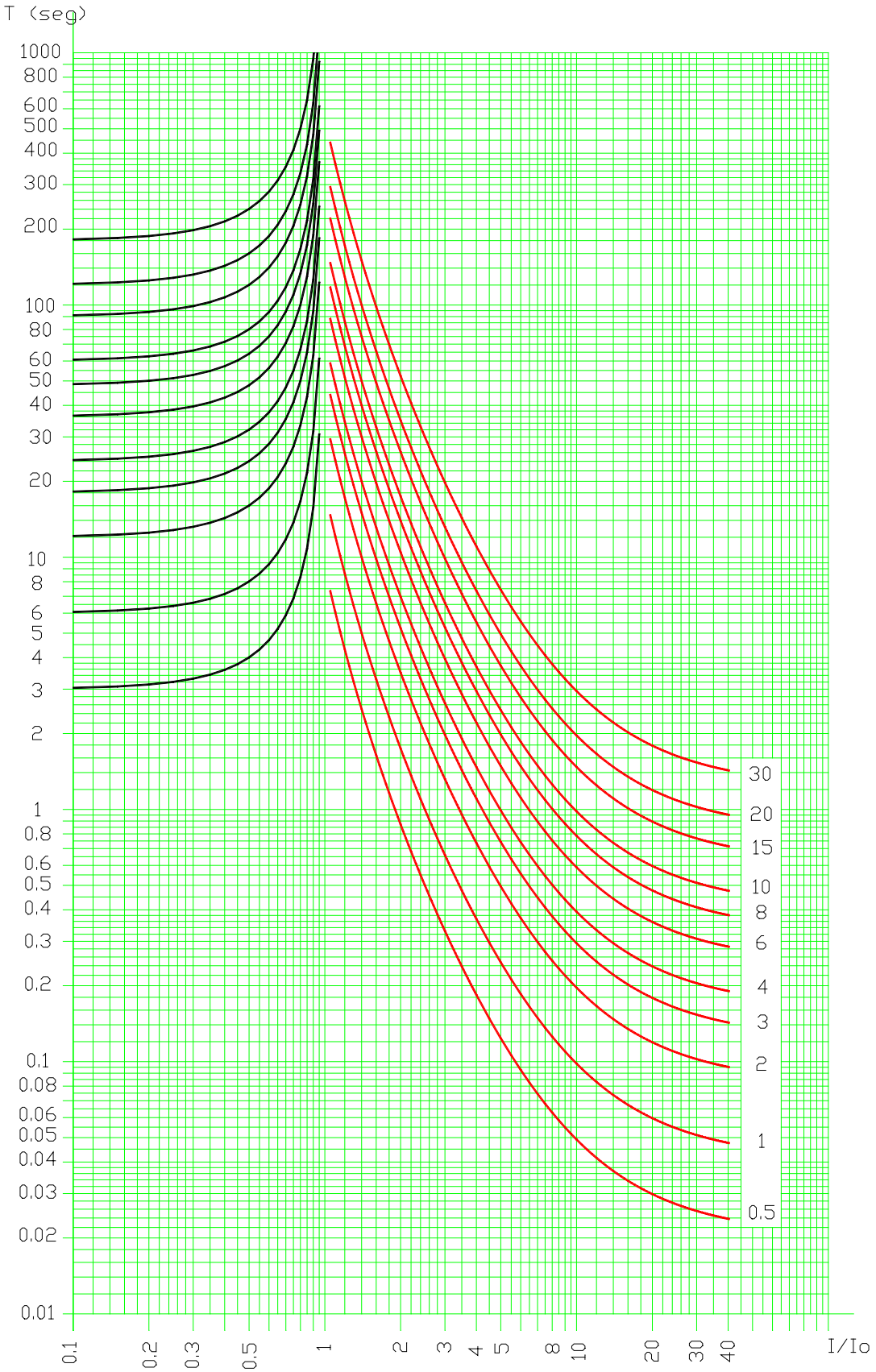
Extremely inverse curve

$$T := M \cdot \left[A + \frac{B}{\left(\frac{I}{I_0} - C\right)} + \frac{D}{\left(\frac{I}{I_0} - C\right)^2} + \frac{E}{\left(\frac{I}{I_0} - C\right)^3} \right] \qquad T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^2 - 1}$$

A = 0.0399, B = 0.2294, C = 0.5000, D = 3.0094, E = 0.7222 tr = 6.008

Theoretical values given by the formula:

M /Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.5	3.004	3.204	4.005	6.866	7.373	6.063	4.307	3.220	2.000	0.872	0.499	0.330	0.124	0.049	0.030	0.024
1.0	6.008	6.409	8.011	13.733	14.746	12.125	8.615	6.439	4.001	1.744	0.997	0.659	0.247	0.098	0.060	0.048
2.0	12.016	12.817	16.021	27.465	29.492	24.250	17.230	12.879	8.002	3.489	1.994	1.319	0.495	0.196	0.119	0.095
3.0	18.024	19.226	24.032	41.198	44.239	36.376	25.844	19.318	12.003	5.233	2.992	1.978	0.742	0.295	0.179	0.143
4.0	24.032	25.634	32.043	54.930	58.985	48.501	34.459	25.758	16.004	6.977	3.989	2.638	0.990	0.393	0.239	0.191
5.0	30.040	32.043	40.053	68.663	73.731	60.626	43.074	32.197	20.004	8.722	4.986	3.297	1.237	0.491	0.298	0.238
6.0	36.048	38.451	48.064	82.395	88.477	72.751	51.689	38.636	24.005	10.466	5.983	3.956	1.484	0.589	0.358	0.286
7.0	42.056	44.860	56.075	96.128	103.224	84.876	60.303	45.076	28.006	12.210	6.981	4.616	1.732	0.688	0.418	0.334
8.0	48.064	51.268	64.085	109.861	117.970	97.002	68.918	51.515	32.007	13.955	7.978	5.275	1.979	0.786	0.477	0.381
9.0	54.072	57.677	72.096	123.593	132.716	109.127	77.533	57.954	36.008	15.699	8.975	5.934	2.227	0.884	0.537	0.429
10.0	60.080	64.085	80.107	137.326	147.462	121.252	86.148	64.394	40.009	17.443	9.972	6.594	2.474	0.982	0.597	0.476
11.0	66.088	70.494	88.117	151.058	162.208	133.377	94.763	70.833	44.010	19.188	10.969	7.253	2.722	1.081	0.656	0.524
12.0	72.096	76.902	96.128	164.791	176.955	145.502	103.377	77.273	48.011	20.932	11.967	7.913	2.969	1.179	0.716	0.572
13.0	78.104	83.311	104.139	178.523	191.701	157.628	111.992	83.712	52.012	22.676	12.964	8.572	3.216	1.277	0.776	0.619
14.0	84.112	89.719	112.149	192.256	206.447	169.753	120.607	90.151	56.013	24.421	13.961	9.231	3.464	1.375	0.835	0.667
15.0	90.120	96.128	120.160	205.989	221.193	181.878	129.222	96.591	60.013	26.165	14.958	9.891	3.711	1.474	0.895	0.715
16.0	96.128	102.537	128.171	219.721	235.940	194.003	137.837	103.030	64.014	27.909	15.956	10.550	3.959	1.572	0.955	0.762
17.0	102.136	108.945	136.181	233.454	250.686	206.128	146.451	109.470	68.015	29.654	16.953	11.210	4.206	1.670	1.014	0.810
18.0	108.144	115.354	144.192	247.186	265.432	218.254	155.066	115.909	72.016	31.398	17.950	11.869	4.453	1.768	1.074	0.858
19.0	114.152	121.762	152.203	260.919	280.178	230.379	163.681	122.348	76.017	33.142	18.947	12.528	4.701	1.866	1.134	0.905
20.0	120.160	128.171	160.213	274.651	294.924	242.504	172.296	128.788	80.018	34.887	19.944	13.188	4.948	1.965	1.194	0.953
21.0	126.168	134.579	168.224	288.384	309.671	254.629	180.910	135.227	84.019	36.631	20.942	13.847	5.196	2.063	1.253	1.001
22.0	132.176	140.988	176.235	302.117	324.417	266.754	189.525	141.666	88.020	38.375	21.939	14.506	5.443	2.161	1.313	1.048
23.0	138.184	147.396	184.245	315.849	339.163	278.879	198.140	148.106	92.021	40.120	22.936	15.166	5.691	2.259	1.373	1.096
24.0	144.192	153.805	192.256	329.582	353.909	291.005	206.755	154.545	96.022	41.864	23.933	15.825	5.938	2.358	1.432	1.144
25.0	150.200	160.213	200.267	343.314	368.655	303.130	215.370	160.985	100.022	43.608	24.931	16.485	6.185	2.456	1.492	1.191
26.0	156.208	166.622	208.277	357.047	383.402	315.255	223.984	167.424	104.023	45.353	25.928	17.144	6.433	2.554	1.552	1.239
27.0	162.216	173.030	216.288	370.779	398.148	327.380	232.599	173.863	108.024	47.097	26.925	17.803	6.680	2.652	1.611	1.286
28.0	168.224	179.439	224.299	384.512	412.894	339.505	241.214	180.303	112.025	48.841	27.922	18.463	6.928	2.751	1.671	1.334
29.0	174.232	185.847	232.309	398.245	427.640	351.631	249.829	186.742	116.026	50.586	28.920	19.122	7.175	2.849	1.731	1.382
30.0	180.240	192.256	240.320	411.977	442.387	363.756	258.444	193.182	120.027	52.330	29.917	19.782	7.422	2.947	1.790	1.429



VERY INVERSE CURVE

Moderately inverse curve

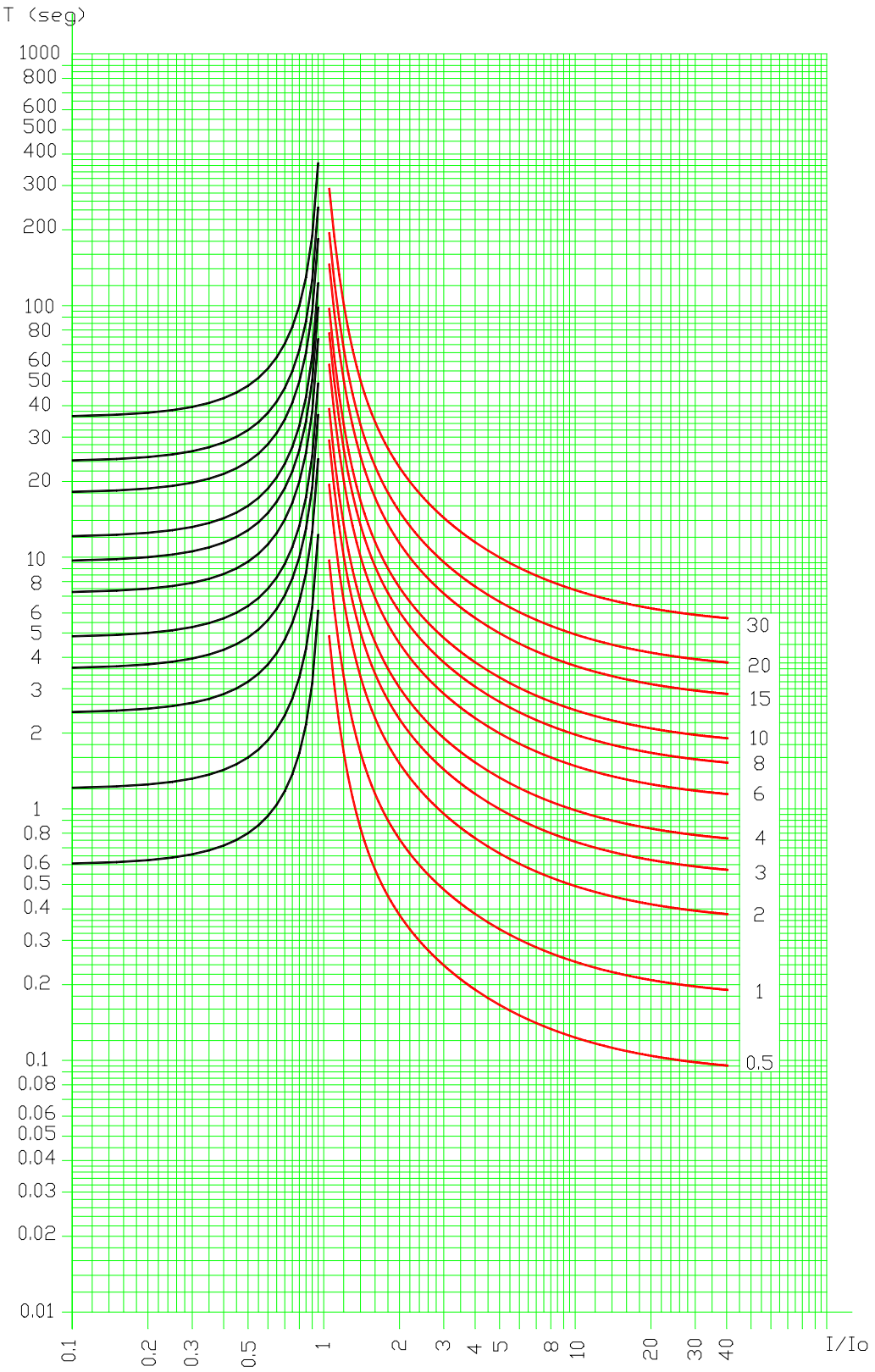
$$T := M \cdot \left[A + \frac{B}{\left(\frac{I}{I_0} - C\right)} + \frac{D}{\left(\frac{I}{I_0} - C\right)^2} + \frac{E}{\left(\frac{I}{I_0} - C\right)^3} \right]$$

$$T_{DROPOUT} := M \cdot \frac{t_r}{\left(\frac{I}{I_0}\right)^2 - 1}$$

A = 0.1735, B = 0.6791, C = 0.8000, D = -0.0800, E = 0.1271 tr = 1.2

Theoretical values given by the formula:

M I/Io	0	0.25	0.5	0.75	1.05	1.10	1.20	1.30	1.50	2.00	2.50	3.00	5.00	10.00	20.00	40.00
0.5	0.600	0.640	0.800	1.371	4.872	3.128	1.679	1.114	0.675	0.379	0.286	0.239	0.166	0.123	0.104	0.095
1.0	1.200	1.280	1.600	2.743	9.744	6.256	3.357	2.229	1.351	0.757	0.571	0.478	0.332	0.247	0.209	0.191
2.0	2.400	2.560	3.200	5.486	19.489	12.511	6.714	4.457	2.702	1.515	1.142	0.955	0.665	0.493	0.417	0.382
3.0	3.600	3.840	4.800	8.229	29.233	18.767	10.072	6.686	4.053	2.272	1.713	1.433	0.997	0.740	0.626	0.572
4.0	4.800	5.120	6.400	10.971	38.977	25.023	13.429	8.914	5.404	3.030	2.285	1.910	1.329	0.986	0.835	0.763
5.0	6.000	6.400	8.000	13.714	48.722	31.278	16.786	11.143	6.755	3.787	2.856	2.388	1.662	1.233	1.043	0.954
6.0	7.200	7.680	9.600	16.457	58.466	37.534	20.143	13.371	8.106	4.544	3.427	2.866	1.994	1.479	1.252	1.145
7.0	8.400	8.960	11.200	19.200	68.210	43.790	23.500	15.600	9.457	5.302	3.998	3.343	2.327	1.726	1.461	1.335
8.0	9.600	10.240	12.800	21.943	77.954	50.045	26.857	17.828	10.807	6.059	4.569	3.821	2.659	1.972	1.669	1.526
9.0	10.800	11.520	14.400	24.686	87.699	56.301	30.215	20.057	12.158	6.817	5.140	4.298	2.991	2.219	1.878	1.717
10.0	12.000	12.800	16.000	27.429	97.443	62.557	33.572	22.285	13.509	7.574	5.712	4.776	3.324	2.465	2.087	1.908
11.0	13.200	14.080	17.600	30.171	107.187	68.813	36.929	24.514	14.860	8.332	6.283	5.253	3.656	2.712	2.295	2.099
12.0	14.400	15.360	19.200	32.914	116.932	75.068	40.286	26.742	16.211	9.089	6.854	5.731	3.988	2.958	2.504	2.289
13.0	15.600	16.640	20.800	35.657	126.676	81.324	43.643	28.971	17.562	9.846	7.425	6.209	4.321	3.205	2.713	2.480
14.0	16.800	17.920	22.400	38.400	136.420	87.580	47.001	31.199	18.913	10.604	7.996	6.686	4.653	3.451	2.921	2.671
15.0	18.000	19.200	24.000	41.143	146.165	93.835	50.358	33.428	20.264	11.361	8.567	7.164	4.986	3.698	3.130	2.862
16.0	19.200	20.480	25.600	43.886	155.909	100.091	53.715	35.656	21.615	12.119	9.139	7.641	5.318	3.945	3.339	3.052
17.0	20.400	21.760	27.200	46.629	165.653	106.347	57.072	37.885	22.966	12.876	9.710	8.119	5.650	4.191	3.547	3.243
18.0	21.600	23.040	28.800	49.371	175.398	112.602	60.429	40.113	24.317	13.633	10.281	8.597	5.983	4.438	3.756	3.434
19.0	22.800	24.320	30.400	52.114	185.142	118.858	63.787	42.342	25.668	14.391	10.852	9.074	6.315	4.684	3.965	3.625
20.0	24.000	25.600	32.000	54.857	194.886	125.114	67.144	44.570	27.019	15.148	11.423	9.552	6.647	4.931	4.173	3.815
21.0	25.200	26.880	33.600	57.600	204.630	131.369	70.501	46.799	28.370	15.906	11.994	10.029	6.980	5.177	4.382	4.006
22.0	26.400	28.160	35.200	60.343	214.375	137.625	73.858	49.027	29.720	16.663	12.565	10.507	7.312	5.424	4.591	4.197
23.0	27.600	29.440	36.800	63.086	224.119	143.881	77.215	51.256	31.071	17.421	13.137	10.985	7.645	5.670	4.799	4.388
24.0	28.800	30.720	38.400	65.829	233.863	150.136	80.572	53.484	32.422	18.178	13.708	11.462	7.977	5.917	5.008	4.579
25.0	30.000	32.000	40.000	68.571	243.608	156.392	83.930	55.713	33.773	18.935	14.279	11.940	8.309	6.163	5.217	4.769
26.0	31.200	33.280	41.600	71.314	253.352	162.648	87.287	57.941	35.124	19.693	14.850	12.417	8.642	6.410	5.425	4.960
27.0	32.400	34.560	43.200	74.057	263.096	168.903	90.644	60.170	36.475	20.450	15.421	12.895	8.974	6.656	5.634	5.151
28.0	33.600	35.840	44.800	76.800	272.841	175.159	94.001	62.398	37.826	21.208	15.992	13.373	9.306	6.903	5.843	5.342
29.0	34.800	37.120	46.400	79.543	282.585	181.415	97.358	64.627	39.177	21.965	16.564	13.850	9.639	7.149	6.051	5.532
30.0	36.000	38.400	48.000	82.286	292.329	187.671	100.716	66.855	40.528	22.722	17.135	14.328	9.971	7.396	6.260	5.723



CARACT. MODERADAMENTE INVERSA

IX.3. USER CURVES

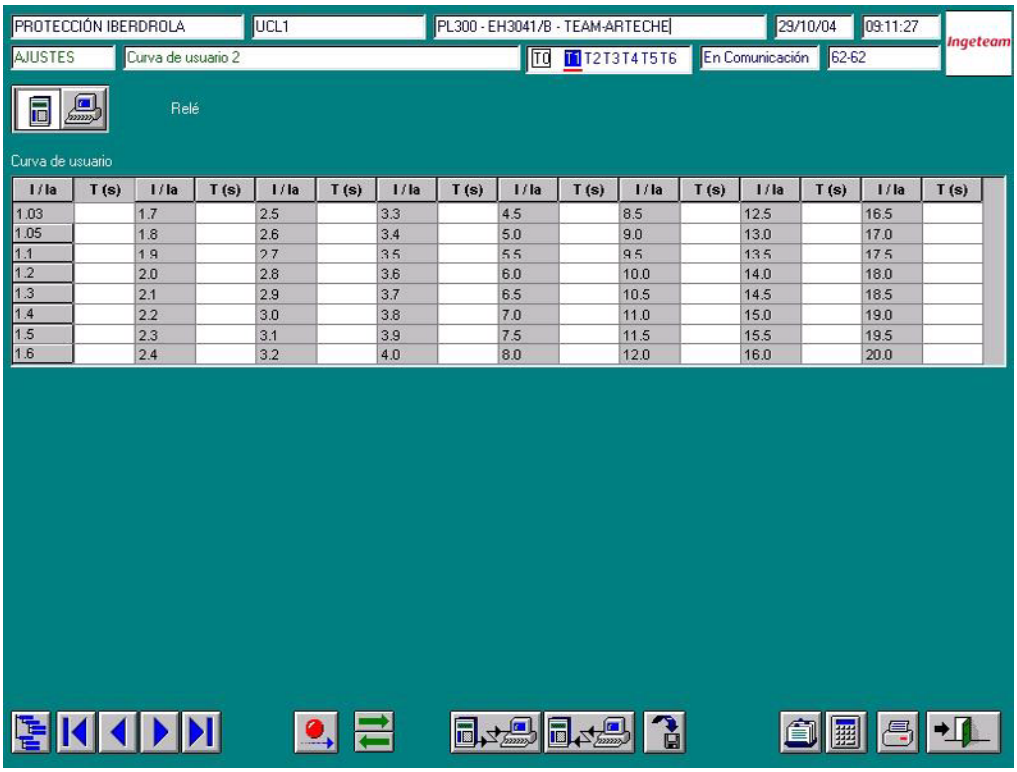
The user can programme one curve, by introducing the points he wants in the corresponding console screen “User curve 1”.

The time corresponding to each I/Ia is programmed in seconds, with a minimum value of 0.020 seconds. These times correspond to the curve of index 1, but as in curves IEC, the user can programme a time index between 0.05 and 1.09 in the overcurrent protection settings.

All the points of the temple do not have to be programmed. The console will assign the time of the first point programmed to all of the I/Ia lower than itself, and the one of the last time programmed to all of the I/Ia higher than itself, that is, the graphic will start and end in horizontal lines. The intermediate points between two programmed points will be calculated by the console as a lineal interpolarization between both.

Programming for a value of I/Ia of a time higher than the corresponding one to a lower I/Ia is accepted, that is, increasing lines are not allowed.

Programming template:



I / Ia	T (s)	I / Ia	T (s)	I / Ia	T (s)	I / Ia	T (s)	I / Ia	T (s)	I / Ia	T (s)	I / Ia	T (s)	I / Ia	T (s)
1.03		1.7		2.5		3.3		4.5		8.5		12.5		16.5	
1.05		1.8		2.6		3.4		5.0		9.0		13.0		17.0	
1.1		1.9		2.7		3.5		5.5		9.5		13.5		17.5	
1.2		2.0		2.8		3.6		6.0		10.0		14.0		18.0	
1.3		2.1		2.9		3.7		6.5		10.5		14.5		18.5	
1.4		2.2		3.0		3.8		7.0		11.0		15.0		19.0	
1.5		2.3		3.1		3.9		7.5		11.5		15.5		19.5	
1.6		2.4		3.2		4.0		8.0		12.0		16.0		20.0	

Below there is an example

I/Ia	2	4	8	12	15
T (s)	200	100	70	50	5

APPENDIX X. LIST OF AVAILABLE SIGNALS

The following list includes all the available signals in the complete PL70 family. For each model of the family only the signals corresponding to its available functions will be applied.

In the case of Procome Protocol it can be programmed which of the signals are sent to control, as well as the number they are sent with. The number indicated is that the signals had in the versions in which it was fixed (up to firmware version D included).

Signal Nº	Signal	
0.	Phase instantaneous pickup (50)	
1.	Neutral instantaneous pickup (50N)	
2.	Sensitive neutral instantaneous pickup (50SN)	
3.	Phase instantaneous pickup High 1 (50H1)	
4.	Neutral instantaneous pickup High 1 (50NH1)	
5.	TCP/IP transmission	
6.	Automatism into operation	
7.	Automatism inhibit	
8.	Phase timed pickup (51)	
9.	Neutral timed pickup (51N)	
10.	Sensitive neutral timed pickup (51SN)	
11.	51H2-Phases TOC Pick.(Hi2)	
12.	51NH2-Gnd TOC Pick.(Hi2)	
13.	51NSH2-S.G.TOC Pick.(Hi2)	
14.	Isolated neutral pickup (67IN)	
15.	Thermal image alarm (49)	
16.	Phase instantaneous trip (50)	
17.	Neutral instantaneous trip (50N)	
18.	Sensitive neutral instantaneous trip (50SN)	
19.	Phase instantaneous trip High 1 (50H1)	
20.	Neutral instantaneous trip High 1 (50NH1)	
21.	50H2-Phase IOC Trip (Hi2)	
22.	50NH2-Gnd IOC Trip (Hi2)	
23.	50NSH2-S.G. IOC Trip (Hi2)	
24.	Phase timed trip (51)	
25.	Neutral timed trip (51N)	
26.	Sensitive neutral timed trip (51SN)	
27.	51H2-Phases TOC Trip (Hi2)	SNTP1 server failure (Family SC, RC, CT and RS)
28.	51NH2-Gnd TOC Trip (Hi2)	SNTP2 server failure (Family SC, RC, CT and RS)
29.	51NSH2-S.G. TOC Trip (Hi2)	SNTP1 server LOCAL/REMOTE (Family SC, RC, CT and RS)

30. Isolated neutral trip (67IN)
31. Thermal image trip (49)
32. Unbalance timed trip (46T)
33. Unbalance instantaneous trip (46)
34. Broken conductor trip (46BC)
35. Breaker failure trip (50BF)
36. Unbalance timed pickup (46T)
37. Unbalance instantaneous pickup (46)
38. Broken conductor pickup (46BC)
39. Breaker failure pickup (50BF)
40. Free
41. Activation 51V (51V)
42. Cold Load Pickup (CLP)
43. Overcurrent pickup (50x/51x/46x)
44. Overcurrent trip (50x/51x/46x)
45. Phase A overcurrent trip (50A/51A)
46. Phase B overcurrent trip (50B/51B)
47. Phase C overcurrent trip (50C/51C)
48. Phase overvoltage timed trip (59)
49. Phase undervoltage timed trip (59)
50. Phase overvoltage instantaneous trip (59)
51. Phase undervoltage instantaneous trip (27)
52. Neutral overvoltage timed trip (64T)
53. Neutral overvoltage instantaneous trip (64)
54. Voltage unbalance trip (47T)
55. Phase reversal trip (47)
56. Phase overvoltage timed pickup (59)
57. Phase undervoltage timed pickup (27)
58. Phase overvoltage instantaneous pickup (59)
59. Phase undervoltage instantaneous pickup (27)
60. Neutral overvoltage timed pickup (64T)
61. Neutral overvoltage instantaneous pickup (64)
62. Voltage unbalance pickup (47T)
63. Phase reversal pickup (47)
64. Relay in service
65. Recloser in service
66. Ongoing cycle

67. Definitive trip
68. Excessive number of trips
69. Recloser locking
70. Free
71. kI2 exceeded (average 3 poles)
72. kI2 exceeded pole A
73. kI2 exceeded pole B
74. kI2 exceeded pole C
75. Open springs automatism
76. Closure permission by syncrocheck (25)
77. Instantaneous cancellation output (of the recloser)
78. Voltage pickup (27/59/64/47)
79. Voltage trip (27/59/64/47)
80. Digital input 1
81. Digital input 2
82. Digital output 1
83. Digital output 2
84. Digital output 3
85. Digital output 4
86. Digital output 5
87. Digital output 6
88. Instantaneous trip
89. Instantaneous pick up
90. Time trip
91. Time pick up
92. Overvoltage trip
93. Overvoltage pick up
94. Undervoltage trip
95. Settings modified by 51 V (mode 1)
96. Digital input 3
97. Digital input 4
98. Digital input 5
99. Digital input 6
100. Digital input 7
101. Digital input 8
102. Digital output 7
103. Digital output 8

104. Digital output 9
105. Digital output 10
106. Digital output 11
107. Free
108. Internal battery level low
109. IRIG-B failure
110. State 52 change
111. Active table change
112. Logic output 1
113. Logic output 2
114. Logic output 3
115. Logic output 4
116. Logic output 5
117. Logic output 6
118. Logic output 7
119. Logic output 8
120. Logic output 9
121. Logic output 10
122. Phase HIGH CURRENT pickup (50HC)
123. Neutral HIGH CURRENT pickup (50NHC)
124. Phase HIGH CURRENT trip (50HC)
125. Neutral HIGH CURRENT trip (50NHC)
126. Reclosure
127. Automatism: Voltage presence
128. Breaker open failure
129. Breaker close failure
130. Breaker close command
131. Breaker open command
132. General pickup
133. General trip
134. Breaker closed (52status)
135. Oscillograph recorder pickup
136. Free
137. Free
138. LOCAL status
139. Trip circuit 1 failure
140. Free

141. Close circuit 1 failure
142. Free
143. HW status
144. Min. power trip (Family PO)
145. Max. power trip High (Family PO)
146. Max. power trip Low (Family PO)
147. Power reverse trip High (Family PO)
148. Power reverse trip Low(Family PO)
149. Free
150. Free
151. Power trip (Family PO)
152. Min. power pick up (Family PO)
153. Max. power trip High pick up (Family PO)
154. Max. power trip Low pick up (Family PO)
155. Power reverse trip pick up (Family PO)
156. Power reverse trip Low pick up (Family PO)
157. Free
158. Free
159. Power pickup
160. Frequency trip level 1
161. Frequency trip level 2
162. Frequency trip level 3
163. Frequency trip level 4
164. Frequency trip level 5
165. df/dt trip level 1
166. df/dt trip level 2
167. df/dt trip level 3
168. df/dt trip level 4
169. Frequency pickup level 1
170. Frequency pickup level 2
171. Frequency pickup level 3
172. Frequency pickup level 4
173. Frequency pickup level 5
174. Frequency trip
175. Trip by df/dt
176. Free
177. Free

Undervolt. pick up phase A (Family TT and SV)
Undervolt. pick up phase B (Family TT and SV)
Undervolt. pick up phase C (Family TT and SV)
Undervolt. trip phase A (Family TT and SV)
Undervolt. trip phase B (Family TT and SV)
Undervolt. trip phase C (Family TT and SV)
Overvolt. pick up phase A (Family TT and SV)
Overvolt. pick up phase B (Family TT and SV)
Overvolt. pick up phase C (Family TT and SV)
Overvolt. trip phase A (Family TT and SV)
Overvolt. trip phase B (Family TT and SV)
Overvolt. trip phase C (Family TT and SV)
Low Current Pickup level 1 (Family IS and IT)
Low Current Trip level 1 (Family IS and IT)
Low Current Pickup level 2 (Family IS and IT)
Low Current Trip level 2 (Family IS and IT)
Temp. Phase Fault Step (Family SC, RC and RS)
Temp. Neutral Fault Step (Family SC, RC and RS)
Temp. Phase Fault Sign (Family SC, RC and RS)
Temp. Neutral Fault Sign (Family SC, RC and RS)
Inst. S.Gnd Fault Sign (Family SC, RC and RS)
Temp. S.Gnd Fault Sign (Family SC, RC and RS)
Inst. S.Gnd Fault Step (Family SC, RC and RS)
Temp. S.Gnd Fault Step (Family SC, RC and RS)
Voltage OFF (Family SC, RC and RS)
Extinguished current (Family SC, RC and RS)

178. Free
179. Free
180. Module difference
181. Frequency difference
182. Angle difference
183. 50H2-Phase IOC Pick.(Hi2)
184. 50NH2-Gnd IOC Pick.(Hi2)
185. 50NSH2-S.G. IOC Pick.(Hi2)
186. Voltage OFF in 1 or 2 phases
187. Automatism OFF
188. CAPDIS Failure
189. Phase Fault Step
190. Neutral Fault Step
191. Breaker failure trip neutral
192. Minimum apparent power pickup
193. Maximum apparent power pickup High
194. Maximum apparent power pickup Low
195. Minimum apparent power trip
196. Maximum apparent power trip High
197. Maximum apparent power trip Low
198. Free
199. Motor protection trip
200. Rotor locking pick up
201. Rotor locking trip
202. Undercurrent pick up
203. Undercurrent trip
204. Long start
205. Starts per hour
206. Start
207. Start in process
208. MHO1 trip
209. MHO2 trip
210. MHO1 alarm
211. MHO2 alarm
212. MHO1 undervoltage condition
213. MHO2 undervoltage condition
214. Overexcitation trip

215. Phase shift trip
216. Overexcitation time pick up
217. Overexcitation instantaneous pick up
218. Overexcitation time trip
219. Overexcitation instantaneous trip
220. Phase A shift
221. Phase B shift
222. Phase C shift
223. Three phase shift
224. 81-Lock Freq.Prot.min.V
225. 81R-Lock DF/DT Prot.min.V
226. Voltage absence
227. Spring motor opening
228. Inst. Phase Fault Sign (Family SC, RC and RS)
229. Inst. Neutral Fault Sign (Family SC, RC and RS)
230. Free
231. Free
232. Current pass due to phase fault detection
233. Automation
234. Telecommand
235. Door opening (telecontrol center)
236. Free
237. Free
238. Free
239. Free
240. Phase A Forward (Family RS)
241. Phase A Reverse (Family RS)
242. Free
243. Free
244. Phase C Forward (Family RS)
245. Phase C Reverse (Family RS)
246. Free
247. Free
248. Neutral Forward (Family RS)
249. Neutral Reverse (Family RS)
250. 79f-Freq. Recl. locked
251. 79f-Freq. Recl. In service

Inst. Phase Fault Step (Family SC, RC and RS)
Inst. Neutral Fault Step (Family SC, RC and RS)

252. 79f-Freq. reclosure
253. 79f-breaker close locking
254. 79f-Freq. Definitive trip
255. V abs. with I pres. anomaly
256. Side A and B undervoltage pickup
257. Side A undervoltage pickup
258. Side B undervoltage pickup
259. Side A and B undervoltage trip
260. Lack of synchronism
261. Underfrequency Teleacoplator
262. Overfrequency Teleacoplator
263. Phase delay Teleacoplator
264. Phase forward Teleacoplator
265. Module dif. Teleacoplator
266. Teleacoplator close command
267. Teleacoplator working
268. Teleacoplator cancelled
269. Teleacoplator not selected
270. Restricted earth pick up
271. Restricted earth trip
272. Residual overcurrent instantaneous pickup
273. Residual overcurrent time pickup
274. Residual overcurrent instantaneous trip
275. Residual overcurrent time trip
276. Earthed overcurrent instantaneous pick up (Neutral 2)
277. Earthed overcurrent time pick up (Neutral 2)
278. Earthed overcurrent instantaneous trip (Neutral 2)
279. Earthed overcurrent time trip (Neutral 2)
280. Tank overcurrent instantaneous pick up (Neutral 3)
281. Tank overcurrent time pick up (Neutral 3)
282. Tank overcurrent instantaneous trip (Neutral 3)
283. Tank overcurrent time trip (Neutral 3)
284. High 1 Sensitive neutral instantaneous pick up (50H1)
285. High 1 Sensitive neutral instantaneous High 1 (50H1)
286. Dead zone pick up
287. Dead zone trip
288. Recloser on-going cycle 1

289. Recloser on-going cycle 2
290. Recloser on-going cycle 3
291. Recloser on-going cycle 4
292. Manual close security t.
293. 1st recloser security t.
294. 2nd recloser security t.
295. 3rd recloser security t.
296. 4th recloser security t.
297. Table 1 active
298. Table 2 active
299. Table 3 active
300. Table 4 active
301. Recloser on standby
302. Rear arch pick up (I)
303. Rear arch trip(I)
304. Arch phase A (I) pick up
305. Arch phase B (I) pick up
306. Arch phase C (I) pick up
307. Arch phase A (I) trip
308. Arch phase B (I) trip
309. Arch phase C (I) trip
310. Breaker failure (BF) in fault retrip
311. Phase A retrip
312. Phase B retrip
313. Phase C retrip
314. BF in load pick up
315. BF in load 2 trip
316. BF in load 1 trip
317. Phase A load trip 1
318. Phase B load trip 1
319. Phase C load trip 1

APPENDIX XI. DNP 3.0 RTU COMMUNICATION PROTOCOL

This function allows communicating with a remote control station, using the communication protocol DNP3 at the level of control messages.

The unit behaves as a remote position RTU.

The format by character is:

1 start bit.

8 data bits.

1 parity bit configurable between none, even and odd parity.

1 stop bit, configurable between 1 and 2 stop bit.

The baud rate can be selected among 300, 600, 1200, 2400, 4800, 9600, 19200 and 38400 bauds.

XI.1. SETTING

Associated text	Meaning
UCL. ADDRESS	Word type parameter. It allows identifying the number of remote station. Range 0 - 65532. Default value 1.
MASTER ADDRESS	Word type parameter. It allows identifying the master station address. Range 0 - 65532. Default value 0.
BAUD RATE	This word type parameter allows to set the baud rate : 300 – 600 – 1200 – 2400 – 4800 – 9600 – 19200 - 38400) bauds. Default value 9600
PARITY T.	It allows configuring the parity to be used in the transmission. Even, odd or none parity. The advised default value is none parity, as indicated in DNP3 protocol.
STOP BITS	It allows selecting the number of stop bits. 1 or 2 stop bits The advised default value is 1 stop bit, as indicated in DNP3 protocol.
FIXED RTS	When its value is YES the RTS signal is kept permanently active. Default value NO.
RTS AND CTS	It allows to select if the control if pins RTS and CTS is performed: NO, RTS+CTS, RTS Default value NO
CTS WAIT T.	It indicates the time in hundredths of second, which is being waited for the CTS activation, after the RTS activation. Range 0 - 100. Default value 20.
POR. WAIT T.	It indicates the time, in hundredths of second, which is being waited, once activated the CTS, to start the transmission with the objective to stabilise the carrier. Range 0 - 100. Default value 4.
STABIL T.	Waiting time to transmit after reception, in hundredths of second. Range 0 - 100. Default value 4.
POSTTR. T.	It indicates the time elapsed from the moment the the last character is until the RTS is deactivated RTS (milliseconds). Range: 0 - 3000. Dafault value 40. Note: Available from firmware version E on.
ACK WAIT T.	Waiting timeout to confirm the csc link. Range 0 - 1000. Default value 500.
SYNCHRON. T	Required time in minutes to ask the master for synchronization Range 0 - 10. Default value 0.
ACK LINK	Indicates if confirm is required al link level. SI = confirm is required. NO = confirm. is not required Default value NO.
APLIC. M. BYTES No	Maximum number of bytes in an application segment. Range 1024 - 3072. Default value 1024.

Associated text	Meaning
CHANGES TIME	Transfer time of the default changes. It can take the following values: BOTH = sent with absolute and relative values. WITHOUT TIME = sent without time. ABSOLUTE = sent with absolute time. RELATIVE = sent with relative time. Default value ABSOLUTE.
FROZEN T.	It indicates if the counters are frozen with or without time. It performs only in the case that a 0 variation is requested. WITH TIME = sent with time. WITHOUT TIME = sent without time. Default value WITH TIME..
STATUS SENDING	It indicates if in the answer message to a class 0 data request, the objects of digital signals, measurements and counters with or without status are sent. Value 0->it does not send status for any signal. bit 0-> to one it is sent all with status. bit 1->it sends digital signals with status. bit 2->it sends measurements with status. bit 3->it sends counters with status. bit 4->it sends frozen counters with status. There are two ways to send everything with status: to write a 1 or a 14 Default value 0
MEAS. BIT No.	It indicates the format in which the counters are sent when the Var field is not specified in the request, and as non requested changes. 16 BITS = they are sent in 16 bits. 32 BITS = they are sent in 32 bits. Default value 16 BITS.
COUNTER BIT No.	It indicates the format in which the counters are sent when the Var field is not specified in the request, and as non requested changes. 16 BITS = se envían en 16 bits. 32 BITS = se envían en 32 bits. Default value 32 BITS.
NOT REQ. MESS.	At value YES it allows the transfer of non requested messages with class data 1, 2 or 3. Default value NO.
PR.COLLISION	At value YES a treatment is performed to prevent collisions. At value NO the DCD is not checked. Default value NO.
COL FIXED T.	Waiting time set in hundredths of second which the unit waits since it is allowed to transfer through the DCD. Range 0 - 1000. Range 0 - 1000. Default value 10..
COL.VBLE T.	Variable waiting time. Depending on the selected value it can be obtained the maximum value which can be reached by the hundredths of seconds. This value will be a random value between 0 and such maximum. Possible values: 1-3-5-7-15-31-63-127-255 *Note: it must be highlighted that the time delay is reset once the DCD is lost.* Default value 7.
RESENDING T.	It is the time in seconds in which the unit waits to try again the transfer of non requested data, when it does not receive the link confirmation and the application to an old transfer and its reattempt after the answer waiting time. Range 0 – 630 seconds Default value 20.
NOT REQ. MAX. NUM.	Maximum number of repetitions of a non requested message. At infinite zero value. Range 0 - 65535. Default value 0.
SPECIAL	It allows activating some particular aspects of the operation. BIT 0->0x0001 Transfer of actual counters with OBJ=21. BIT 1->0x0002 Reserve. BIT 2->0x0004 Transfer of non requested message up to the included IIN every 10 seconds BIT 3->0x0008 Reserve. BIT 4->0x0010 Reserve. BIT 5->0x0020 Reserve. BIT 6->0x0040 It does not transfer the restart message when starting. BIT 7->0x0080 Trip close. Default value 0.
FORMAT	It indicates the measurements transfer format. COUNTS CALCULATED

XI.2. OPERATION INDICATIONS

XI.2.1 Spontaneous message indicating RESTART

At RTU starting, in the case that the transfer of spontaneous non requested messages is enabled, it will be sent a spontaneous and empty message which activates the bit corresponding to the IIN RESTART requiring application confirmation.

It will stop transferring when receiving the application confirmation with the correct application sequence number. For the repetition times associated to this message, they will be applied as for the rest of the spontaneous messages, except in the number of reattempts before cancelling the message, this means that the setting NOT REQ. MAX is not considered in this message.

XI.2.2 Synchronization

The bit corresponding to Need Time in the IIN is activated periodically according to the value of the setting SYNCHRON. T.

XI.2.3 Treatment and detection of digital changes

It is maintained a circular queue of 1024 changes which stores the changes in the signals in order to transfer them to the control centre. Changes of digital signals by communications can be filtered by configuring 0 class, this can be done for individual signals or for all.

No changes are detected at the starting of the unit and until it does not start communicating.

The setting ERASE DATA ? does not act over the DNP3 protocol.

XI.2.4 Transfer of spontaneous messages

For the transfer of spontaneous messages, if there are any messages stored in the different classes of changes, the priority of classes will be followed, this means that the queue class 1 is emptied first, then the class 2 and last the class 3.

If the parameter NOT REQ. MESSAGES at value 1 is not found, no spontaneous message is sent.

A treatment of collisions will be performed depending on the parameter COLLISION PREV.. The signal DCD is used along with the parameters COL. FIXED T and COL.VBLE. T.

In the case that no answer is obtained to the messages of non requested changes, a reattempt will be performed once expired the time defined by the parameter ACK. WAIT T. Then periodical transfers will be performed according to the parameter RESEND T. Each time a message is repeated, all the new changes will be included in it, so that the message is created again at each repetition.

XI.2.5 Particular aspects of the operation

Only one reading or writing order can be selected or executed each time.

The selection of orders and writings will be kept during 15sc.

There is a queue of digital signals changes.

If frozen counters are requested and these have not been frozen previously, they are answered at value 0 and with time set to 0.

In the event of receiving a request for any system static object and this does not exist, it will be answered up to the IIN and indicating an unknown object.

XI.3. DEVICE PROFILE DOCUMENT

DNP V3.00
DEVICE PROFILE DOCUMENT

Vendor Name: INGETEAM TRANSMISSION & DISTRIBUTION S.A.

Device Name: SIPC

Highest DNP Level Supported:
For Requests Level 3
For Responses Level 3

Device Function:
☐ Master ■ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

Maximum Data Link Frame Size (octets):
Transmitted 292
Received 292

Maximum Application Fragment Size (octets):
Transmitted 1024< >3072(configurable)
Received 1024

Maximum Data Link Re-tries:
☐ None
■ FIX at 1
☐ Configurable, range __ to __

Maximum Application Layer Re-tries:
■ None
☐ Configurable, range ____ to ____

Requires Data Link Layer Confirmation:
☐ Never
☐ Always
☐ Sometimes
■ Configurable PARAMETER DATA_ACK = 1

Requires Application Layer Confirmation:
■ When reporting Event Data
■ When sending multi-fragment responses

Timeouts while waiting for:

Data Link Confirm	☐ None	☐ FIX at _____	☐ Variable	■ Configurable
Complete Appl. Fragment	■ None	☐ FIX at _____	☐ Variable	☐ Configurable
Application Confirm	☐ None	■ FIX at __10 sg____	☐ Variable	☐ Configurable
Complete Appl. Response	■ None	☐ FIX at _____	☐ Variable	☐ Configurable
Others				

Sends/Executes Control Operations:

WRITE Binary Outputs	■ Never	☐Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	■ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	■ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE – NO ACK	☐ Never	■ Always	☐ Sometimes	☐ Configurable
Count > 1	■ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	■ Always	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	■ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	■ Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	■ Always	☐ Sometimes	☐ Configurable
Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable

Reports Binary Input Change Events when no specific variation requested:
☐ Never
☐ Only time-tagged
☐ Only non-time-tagged
■ Configurable to send both, one or the other (attach explanation)

Reports time-tagged Binary Input Change Events when no specific variation requested:
☐ Never
☐ Binary Input Change With Time
☐ Binary Input Change With Relative Time
■ Configurable (attach explanation)

Sends Unsolicited Responses:
☐ Never
■ Configurable (attach explanation)
■ Only certain objects
☐ Sometimes (attach explanation)
■ ENABLE/DISABLE UNSOLICITED Function codes supported

Sends Static Data in Unsolicited Responses:
■ Never
☐ When Device Restarts
☐ When Status Flags Change

Supports Collision Avoidance: Configurable

Collision Avoidance Detection Method: DCD

Default Counter Object/Variation:
☐ No Counters Reported
■ Configurable (attach explanation)
☐ Default Object _____
Default Variation _____
☐ Point-by-point list attached

Counters Roll Over at:
☐ No Counters Reported
☐ Configurable (attach explanation)
☐ 16 Bits
■ 32 Bits
☐ Other Value _____
☐ Point-by-point list attached

Sends Multi-Fragment Responses: ■ Yes ☐ No

XI.4. IMPLEMENTATION TABLE

OBJECT			REQUEST(slave must parse)		RESPONSE(master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
1	0	Binary Input – All Variations	1,22	00,01,06, 07,08		
1	1	Binary Input	1	00,01,06, 07,08	129	00,01
1	2	Binary Input with Status	1	00,01,06, 07,08	129	00,01
2	0	Binary Input Change - All Variations	1	06,07,08		
		20*,21*	06			
2	1	Binary Input Change without Time	1	06,07,08	129, 130	28
2	2	Binary Input Change with Time	1	06,07,08	129, 130	28
2	3	Binary Input Change with Relative Time	1	06,07,08	129, 130	28
10	0	Binary Output - All Variations	1	00,01,06		
10	1	Binary Output				
10	2	Binary Output Status	1	00,01,06	129	00,01
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	Echo of request
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	1, 7, 89, 10,22	00,01,06, 07,08		
20	1	32-Bit Binary Counter	1, 7, 89, 10	00,01,06, 07,08	129	00,01
20	2	16-Bit Binary Counter	1, 7, 89, 10	00,01,06, 07,08	129	00,01
20	3	32-Bit Delta Counter	1	00,01,06, 07,08	129	00,01
20	4	16-Bit Delta Counter	1	00,01,06, 07,08	129	00,01
20	5	32-Bit Binary Counter without Flag	1	00,01,06, 07,08	129	00, 01
20	6	16-Bit Binary Counter without Flag	1	00,01,06, 07,08	129	00, 01
20	7	32-Bit Delta Counter without Flag	1	00,01,06, 07,08	129	00,01
20	8	16-Bit Delta Counter without Flag	1	00,01,06, 07,08	129	00,01
21	0	Frozen Counters - All Variations	1, 22	00,01,06		
21	1	32-Bit Frozen Counter	1	00,01,06	129	00,01
21	2	16-Bit Frozen Counter	1	00,01,06	129	00,01
21	3	32-Bit Frozen Delta Counter	1	00,01,06	129	00,01
21	4	16-Bit Frozen Delta Counter	1	00,01,06	129	00,01
21	5	32-Bit Frozen Counter with Time of Freeze	1	00,01,06	129	00, 01
21	6	16-Bit Frozen Counter with Time of Freeze	1	00,01,06	129	00, 01
21	7	32-Bit Frozen Delta Counter with Time of Freeze	1	00,01,06	129	00,01
21	8	16-Bit Frozen Delta Counter with Time of Freeze	1	00,01,06	129	00,01
21	9	32-Bit Frozen Counter without Flag	1	00,01,06	129	00,01
21	10	16-Bit Frozen Counter without Flag	1	00,01,06	129	00,01
21	11	32-Bit Frozen Delta Counter without Flag	1	00,01,06	129	00,01
21	12	16-Bit Frozen Delta Counter without Flag	1	00,01,06	129	00,01
22	0	Counter Change Event – All Variations	1	06,07,08		
22	1	32-Bit Counter Change Event without Time	1	06,07,08	129, 130	28
22	2	16-Bit Counter Change Event without Time	1	06,07,08	129, 130	28
22	3	32-Bit Delta Counter Change Event without Time	1	06, 07, 08	129	28
22	4	16-Bit Delta Counter Change Event without Time	1	06, 07, 08	129	28
22	5	32-Bit Counter Change Event with Time				
22	6	16-Bit Counter Change Event with Time				
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				
23	0	Frozen Counter Events – All Variations	1	06, 07, 08	129	
23	1	32-Bit Frozen Counter Event without Time	1	06, 07, 08	129	28
23	2	16-Bit Frozen Counter Event without Time	1	06, 07, 08	129	28

OBJECT			REQUEST(slave must parse)		RESPONSE(master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
23	3	32-Bit Frozen Delta Counter Event without Time	1	06, 07, 08	129	28
23	4	16-Bit Frozen Delta Counter Event without Time	1	06, 07, 08	129	28
23	5	32-Bit Frozen Counter Event with Time				
23	6	16-Bit Frozen Counter Event with Time				
23	7	32-Bit Frozen Delta Counter Event with Time				
23	8	16-Bit Frozen Delta Counter Event with Time				
30	0	Analog Input - All Variations	1, 22	00,01,06, 07,08		
30	1	32-Bit Analog Input	1	00,01,06, 07,08	129	00, 01
30	2	16-Bit Analog Input	1	00,01,06, 07,08	129	00,01
30	3	32-Bit Analog Input without flag	1	00,01,06, 07,08	129	00, 01
30	4	16-Bit Analog Input without flag	1	00,01,06, 07,08	129	00, 01
31	0	Frozen Analog Input - All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input with Time of Freeze				
31	4	16-Bit Frozen Analog Input with Time of Freeze				
31	5	32-Bit Frozen Analog Input without Flag				
31	6	16-Bit Frozen Analog Input without Flag				
32	0	Analog Change Event - All Variations	1	06,07,08		
		20*,21*	06			
32	1	32-Bit Analog Change Event without Time	1	06,07,08	129, 130	28
32	2	16-Bit Analog Change Event without Time	1	06,07,08	129, 130	28
32	3	32-Bit Analog Change Event with Time				
32	4	16-Bit Analog Change Event with Time				
33	0	Frozen Analog Event - All Variations				
33	1	32-Bit Frozen Analog Event without Time				
33	2	16-Bit Frozen Analog Event without Time				
33	3	32-Bit Frozen Analog Event with Time				
33	4	16-Bit Frozen Analog Event with Time				
40	0	Analog Output Status - All Variations	1	00, 01, 06		
40	1	32-Bit Analog Output Status	1	00, 01, 06	129	00,01
40	2	16-Bit Analog Output Status	1	00, 01, 06	129	00,01
41	1	32-Bit Analog Output Block				
41	2	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	Echo of request
50	0	Time and Date - All Variations				
50	1	Time and Date	2	07 quantity = 1		
		1	07 quantity = 1		129	07 quantity = 1
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO			129	07, quantity=1
51	2	Unsynchronized Time and Date CTO			129	07, quantity=1
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse				
52	2	Time Delay Fine			129	07, quantity=1
60	0	Not Defined				
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1	06,07,08		
		20, 21,22	06			
60	3	Class 2 Data	1	06,07,08		
		20, 21, 22	06			
60	4	Class 3 Data	1	06,07,08		
		20, 21, 22	06			
70	1	File Identifier				
80	1	Internal Indications	1	00, 01	129	00
		2	00index=7			
81	1	Storage Object				
82	1	Device Profile				

OBJECT			REQUEST(slave must parse)		RESPONSE(master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
		No Object	13, 14			
		No Object	23			

* IBM. Compatibility

XI.5. SIGNAL LIST

XI.5.1 Digital signals

In the list below, the digital signals used (changes and states)are shown. Each model will only be applied those corresponding to the functions it has.

(1) Up to firmware version D the transmitted signals and the order in which they are transmitted are fixed as they are shown in the table.

(2) From the firmware version E on the transmitted signals and the order in which they are transmitted can be programmed among those available. The programming is carried out through the protection console SIPCON/P.

ID-DNP (2)	ID	Signal
Programmable	0	Phase instantaneous pick up (50)
Programmable	1	Neutral instantaneous pick up (50N)
Programmable	2	Sensitive neutral instantaneous pick up (50NS)
Programmable	3	Phase instantaneous pick up High 1 (50H1)
Programmable	4	Neutral instantaneous pick up High 1 (50NH1)
Programmable	5	TCP/IP transmission
Programmable	6	Automatism into operation
Programmable	7	Automatism inhibit
Programmable	8	Phase time pick up (51)
Programmable	9	Neutral time pick up (51N)
Programmable	10	Sensitive neutral time pick up (51NS)
Programmable	11	51H2-Phases TOC Pick.(Hi2)
Programmable	12	51NH2-Gnd TOC Pick.(Hi2)
Programmable	13	51NSH2-S.G.TOC Pick.(Hi2)
Programmable	14	Isolated neutral pick up (67NA)
Programmable	15	Thermal image warning(49)
Programmable	16	Phase instantaneous trip (50)
Programmable	17	Neutral instantaneous trip (50N)
Programmable	18	Sensitive neutral instantaneous trip (50NS)
Programmable	19	Phase instantaneous trip High 1 (50H1)
Programmable	20	Neutral instantaneous trip High 1 (50NH1)
Programmable	21	50H2-Phase IOC Trip(Hi2)
Programmable	22	50NH2-Gnd IOC Trip (Hi2)
Programmable	23	50NSH2-S.G. IOC Trip(Hi2)
Programmable	24	Phase time trip (51)
Programmable	25	Neutral time trip (51N)
Programmable	26	Sensitive neutral time trip (51NS)
Programmable	27	51H2-Phases TOC Trip (Hi2) SNTP1 server failure (Family SC, RC, CT and RS)
Programmable	28	51NH2-Gnd TOC Trip (Hi2) SNTP2 server failure (Family SC, RC, CT and RS)
Programmable	29	51NSH2-S.G. TOC Trip (Hi2) SNTP1 server LOCAL/REMOTE (Family SC, RC, CT and RS)

ID-DNP (2)	ID	Signal
Programmable	30	Isolated neutral trip (67NA)
Programmable	31	Thermal image trip (49)
Programmable	32	Unbalance time trip (46T)
Programmable	33	Unbalance instantaneous trip (46I)
Programmable	34	Broken conductor trip (46BC)
Programmable	35	Breaker failure trip (50BF)
Programmable	36	Unbalance time pick up (46T)
Programmable	37	Unbalance instantaneous pick up (46I)
Programmable	38	Broken conductor pickup (46 BC)
Programmable	39	Breaker failure pickup (50BF)
Programmable	40	Free
Programmable	41	Activation 51V (51V)
Programmable	42	Cold load pick up (CL)
Programmable	43	Overcurrent pick up (50x/51x/46x)
Programmable	44	Overcurrent trip(50x/51x/46x)
Programmable	45	Overcurrent trip Phase A (50A/51A)
Programmable	46	Overcurrent trip Phase B (50B/51B)
Programmable	47	Overcurrent trip Phase C (50C/51C)
Programmable	48	Phase overvoltage time trip (59)
Programmable	49	Phase undervoltage time trip (59)
Programmable	50	Phase overvoltage instantaneous trip (59)
Programmable	51	Phase undervoltage instantaneous trip (59)
Programmable	52	Neutral overvoltage time trip (64T)
Programmable	53	Neutral overvoltage instantaneous trip (64)
Programmable	54	Voltage unbalance trip (47T)
Programmable	55	Phase reverse trip (47)
Programmable	56	Phase overvoltage time pickup (59)
Programmable	57	Phase undervoltage time pickup (59)
Programmable	58	Phase overvoltage instantaneous pickup (59)
Programmable	59	Phase undervoltage instantaneous pickup (59)
Programmable	60	Neutral overvoltage time pickup (64T)
Programmable	61	Neutral overvoltage instantaneous pickup (64)
Programmable	62	Voltage unbalance pick up(47T)
Programmable	63	Phase reverse pick up (47)
Programmable	64	Relay in service
Programmable	65	Recloser in service
Programmable	66	On-going cycle
Programmable	67	Definite trip
Programmable	68	Excessive number of trips
Programmable	69	Recloser locking
Programmable	70	Free
Programmable	71	Exceeded kI2 (average 3 poles)
Programmable	72	Exceeded kI2 pole A
Programmable	73	Exceeded kI2 pole B
Programmable	74	Exceeded kI2 pole C
Programmable	75	Automation open springs
Programmable	76	Close permission by syncrocheck (25)
Programmable	77	Output by instantaneous cancellation (of the recloser)
Programmable	78	Voltage pick up (27/59/64/47)
Programmable	79	Voltage trip (27/59/64/47)
Programmable	80	Digital input 1
Programmable	81	Digital input 2
Programmable	82	Digital output 1
Programmable	83	Digital output 2
Programmable	84	Digital output 3
Programmable	85	Digital output 4
Programmable	86	Digital output 5
Programmable	87	Digital output 6
Programmable	88	Instantaneous trip
Programmable	89	Instantaneous pickup
Programmable	90	Time trip
Programmable	91	Time pickup
Programmable	92	Overvoltage trip
Programmable	93	Overvoltage pick up

ID-DNP (2)	ID	Signal	
Programmable	94	Undervoltage trip	
Programmable	95	Settings modified by 51 V (mode 1)	
Programmable	96	Digital input 3	
Programmable	97	Digital input 4	
Programmable	98	Digital input 5	
Programmable	99	Digital input 6	
Programmable	100	Digital input 7	
Programmable	101	Digital input 8	
Programmable	102	Digital output 7	
Programmable	103	Digital output 8	
Programmable	104	Digital output 9	
Programmable	105	Digital output 10	
Programmable	106	Digital output 11	
Programmable	107	Free	
Programmable	108	Internal battery level low	
Programmable	109	IRIG-B failure	
Programmable	110	Status 52 change	
Programmable	111	Active table change	
Programmable	112	Logic output 1	
Programmable	113	Logic output 2	
Programmable	114	Logic output 3	
Programmable	115	Logic output 4	
Programmable	116	Logic output 5	
Programmable	117	Logic output 6	
Programmable	118	Logic output 7	
Programmable	119	Logic output 8	
Programmable	120	Logic output 9	
Programmable	121	Logic output 10	
Programmable	122	High Current phases pick up (50HC)	
Programmable	123	High Current Neutral pick up (50NHC)	
Programmable	124	High Current phases trip (50HC)	
Programmable	125	High Current Neutral trip (50NHC)	
Programmable	126	Recloser	
Programmable	127	Automation: Voltage presence	
Programmable	128	Breaker open failure	
Programmable	129	Breaker close failure	
Programmable	130	Breaker close command	
Programmable	131	Breaker open command	
Programmable	132	General pick up	
Programmable	133	General trip	
Programmable	134	Close breaker (state 52)	
Programmable	135	Oscillograph pickup	
Programmable	136	Free	
Programmable	137	Free	
Programmable	138	LOCAL state	
Programmable	139	Trip circuit 1 failure	
Programmable	140	Free	
Programmable	141	Close circuit 1 failure	
Programmable	142	Free	
Programmable	143	HW state	
Programmable	144	Minimum power trip	Undervoltage Pick up Phase A (Family TT and SV)
Programmable	145	Maximum power trip High	Undervoltage Pick up Phase B (Family TT and SV)
Programmable	146	Maximum power trip Low	Undervoltage Pick up Phase C (Family TT and SV)
Programmable	147	Power reverse trip High	Undervoltage Trip Phase A (Family TT and SV)
Programmable	148	Power reverse trip Low	Undervoltage Trip Phase B (Family TT and SV)
Programmable	149	Free	Undervoltage Trip Phase C (Family TT and SV)
Programmable	150	Free	Overvoltage Pick up Phase A (Family TT and SV)
Programmable	151	Power trip	Overvoltage Pick up Phase B (Family TT and SV)
Programmable	152	Minimum power pick up	Overvoltage Pick up Phase C (Family TT and SV)
Programmable	153	Maximum power pick up High	Overvoltage Trip Phase A (Family TT and SV)
Programmable	154	Maximum power pick up Low	Overvoltage Trip Phase B (Family TT and SV)
Programmable	155	Power reverse pick up High	Overvoltage Trip Phase C (Family TT and SV)
Programmable	156	Power reverse pick up Low	Low Current Pickup level 1 (Family IS and IT)
Programmable	157	Free	Low Current Trip level 1 (Family IS and IT)

ID-DNP (2)	ID	Signal	
Programmable	158	Free	Low Current Pickup level 2 (Family IS and IT)
Programmable	159	Power pick up	Low Current Trip level 2 (Family IS and IT)
Programmable	160	Frequency trip level 1	Temp. Phase Fault Step (Family SC, RC and RS)
Programmable	161	Frequency trip level 2	Temp. Neutral Fault Step (Family SC, RC and RS)
Programmable	162	Frequency trip level 3	Temp. Phase Fault Sign (Family SC, RC and RS)
Programmable	163	Frequency trip level 4	Temp. Neutral Fault Sign (Family SC, RC and RS)
Programmable	164	Frequency trip level 5	Inst. S.Gnd Fault Sign (Family SC, RC and RS)
Programmable	165	Trip df/dt level 1	Temp. S.Gnd Fault Sign (Family SC, RC and RS)
Programmable	166	Trip df/dt level 2	Inst. S.Gnd Fault Step (Family SC, RC and RS)
Programmable	167	Trip df/dt level 3	Temp. S.Gnd Fault Step (Family SC, RC and RS)
Programmable	168	Trip df/dt level 4	Voltage OFF (Family SC, RC and RS)
Programmable	169	Frequency pick up level 1	Extinguished current (Family SC, RC and RS)
Programmable	170	Frequency pick up level 2	
Programmable	171	Frequency pick up level 3	
Programmable	172	Frequency pick up level 4	
Programmable	173	Frequency pick up level 5	
Programmable	174	Frequency trip	
Programmable	175	df/dt trip	
Programmable	176	Free	
Programmable	177	Free	
Programmable	178	Free	
Programmable	179	Free	
Programmable	180	Free	
Programmable	181	Free	
Programmable	182	Free	
Programmable	183	50H2-Phase IOC Pick.(Hi2)	
Programmable	184	50NH2-Gnd IOC Pick.(Hi2)	
Programmable	185	50NSH2-S.G. IOC Pick.(Hi2)	
Programmable	186	Voltage OFF in 1 or 2 phases	
Programmable	187	Automatism OFF	
Programmable	188	CAPDIS Failure	
Programmable	189	Phase Fault Step	
Programmable	190	Neutral Fault Step	
Programmable	191	Breaker failure trip BF neutral	
Programmable	192	Apparent minimum power pick up	
Programmable	193	Apparent maximum power pick up High	
Programmable	194	Apparent maximum power pick up Low	
Programmable	195	Apparent minimum power trip	
Programmable	196	Apparent maximum power trip High	
Programmable	197	Apparent maximum power trip Low	
Programmable	198	Free	
Programmable	199	Motor protection trip	
Programmable	200	Rotor locking pickup	
Programmable	201	Rotor locking trip	
Programmable	202	Undercurrent pickup	
Programmable	203	Undercurrent trip	
Programmable	204	Long start	
Programmable	205	Starts per hour	
Programmable	206	Motor picked up	
Programmable	207	Motor picking up	
Programmable	208	MHO1 trip	
Programmable	209	MHO2 trip	
Programmable	210	MHO1 alarm	
Programmable	211	MHO2 alarm	
Programmable	212	Undervoltage Cond. 1	
Programmable	213	Undervoltage Cond 2	
Programmable	214	Overexcitation trip	
Programmable	215	Phase shift trip	
Programmable	216	Overexcitation time pick up	
Programmable	217	Overexcitation instantaneous pick up	
Programmable	218	Overexcitation time trip	
Programmable	219	Overexcitation instantaneous trip	
Programmable	220	Phase A shift	
Programmable	221	Phase B shift	

ID-DNP (2)	ID	Signal	
Programmable	222	Phase C shift	
Programmable	223	Three-phase shift	
Programmable	224	81-Lock Freq.Prot.min.V	Inst. Phase Fault Step(Family SC, RC and RS)
Programmable	225	81R-Lock DF/DT Prot.min.V	Inst. Neutral Fault Step(Family SC, RC and RS)
Programmable	226	Voltage absence	
Programmable	227	Spring motor opening	
Programmable	228	Inst. Phase Fault Sign	
Programmable	229	Inst. Neutral Fault Sign	
Programmable	230	Free	
Programmable	231	Free	
Programmable	232	Fault Step	
Programmable	233	Automation	
Programmable	234	Telecommand	
Programmable	235	Door opening	
Programmable	236	Free	
Programmable	237	Free	
Programmable	238	Free	
Programmable	239	Free	
Programmable	240	Forward phase A	
Programmable	241	Reverse phase A	
Programmable	242	Forward phase B	
Programmable	243	Reverse phase B	
Programmable	244	Forward phase C	
Programmable	245	Reverse phase C	
Programmable	246	Forward Neutral	
Programmable	247	Reverse Neutral	
Programmable	248	Free	
Programmable	249	Free	
Programmable	250	79f-Reclos. Freq. Locked	
Programmable	251	79f-Reclos.Freq. in service	
Programmable	252	79f-Frequency recloser	
Programmable	253	79f-Ongoing cycle frequency	
Programmable	254	79f-Definitetrip Freq.	
Programmable	255	79f-Instantaneous cancellation	
Programmable	256	A and B side undervoltage pickup	
Programmable	257	A side undervoltage pickup	
Programmable	258	B side undervoltage pickup	
Programmable	259	A and B side undervoltage trip	
Programmable	260	Lack of synchronism	
Programmable	261	Underfrequency Teleacoplator	
Programmable	262	Overfrequency Teleacoplator	
Programmable	263	Phase delay Teleacoplator	
Programmable	264	Phase forward Teleacoplator	
Programmable	265	Module dif. Teleacoplator	
Programmable	266	Teleacoplator close command	
Programmable	267	Teleacoplator operating	
Programmable	268	Teleacoplator cancelled	
Programmable	269	Teleacoplator not selected	
Programmable	270	Earth restricted pickup	
Programmable	271	Earth restricted trip	
Programmable	272	Residual int. inst. pickup	
Programmable	273	Residual int. time. pickup	
Programmable	274	Residual int. inst. trip	
Programmable	275	Residual int. time. trip	
Programmable	276	Neutral 2 int. inst. pickup	
Programmable	277	Neutral 2 int. time. pickup	
Programmable	278	Neutral 2 int. inst. trip	
Programmable	279	Neutral 2 int. time. trip	
Programmable	280	Neutral 3 int. inst. pickup	
Programmable	281	Neutral 3 int. time. pickup	
Programmable	282	Neutral 3 int. inst. trip	
Programmable	283	Neutral 3 int. time. trip	
Programmable	284	Sensitive neutral inst pick up(High 1)	

ID-DNP (2)	ID	Signal
Programmable	285	Sensitive neutral inst trip (High 1)
Programmable	286	Dead zone pick up
Programmable	287	Dead zone trip
Programmable	288	On-going cycle 1
Programmable	289	On-going cycle 2
Programmable	290	On-going cycle 3
Programmable	291	On-going cycle 4
Programmable	292	Manual close security t.
Programmable	293	1st recloser security t.
Programmable	294	2nd recloser security t.
Programmable	295	3rd recloser security t.
Programmable	296	4th recloser security t.
Programmable	297	Table 1 active
Programmable	298	Table 2 active
Programmable	299	Table 3 active
Programmable	300	Table 4 active
Programmable	301	Recloser on standby
Programmable	302	Rear arch pick up (I)
Programmable	303	Rear arch trip(I)
Programmable	304	Arch phase A (I) pick up
Programmable	305	Arch phase B (I) pick up
Programmable	306	Arch phase C (I) pick up
Programmable	307	Arch phase A (I) trip
Programmable	308	Arch phase B (I) trip
Programmable	309	Arch phase C (I) trip
Programmable	310	Breaker failure (BF) in fault Retrip
Programmable	311	Retrip phase A
Programmable	312	Retrip phase B
Programmable	313	Retrip phase C
Programmable	314	BFpick up in load
Programmable	315	BF trip in load 2
Programmable	316	BF trip in load 1
Programmable	317	Load 1 trip phase A
Programmable	318	Load 1 trip phase B
Programmable	319	Load 1 trip phase C

XI.5.2 Analogue measurements

Vn is the programmed nominal current.

In is the unit's rated current (in case of 1-5 A unified rated current it corresponds to 5 A)

DNP ID (2)	DNP ID (1)	Format	Scale range	Data
Program.	0	Counts	1.2*In (A)	Current maximeter
Program.	1	Counts	$\sqrt{3}$*V_n * 1.2	VSYNC module
Program.	2	Counts	$\sqrt{3}$*V_n * 1.2	VA module
Program.	3	Counts	$\sqrt{3}$*V_n * 1.2	VB module
Program.	4	Counts	$\sqrt{3}$*V_n * 1.2	VC module
Program.	5	Counts	$\sqrt{3}$*V_n * 1.2	VAVERAGE module
Program.	6	Counts	$\sqrt{3}$*V_n * 1.2	VAB (compound voltage) module
Program.	7	Counts	$\sqrt{3}$*V_n * 1.2	VBC (compound voltage) module
Program.	8	Counts	$\sqrt{3}$*V_n * 1.2	VCA (compound voltage) module
Program.	9	Counts	$\sqrt{3}$*V_n * 1.2	VCAVERAGE (compound voltage)
Program.	10	Counts	1.2*In (A)	IA module
Program.	11	Counts	1.2*In (A)	IB module
Program.	12	Counts	1.2*In (A)	IC module
Program.	13	Counts	1.2*In (A)	IAVERAGE module
Program.	14	Counts	1.2*In (A)	IN module
Program.	15	Counts	3*V_n * 1.2 * 6	P (Active power)

DNP ID (2)	DNP ID (1)	Format	Scale range	Data
Program.	16	Counts	$3*V_n * 1.2 * 6$	Q (Reactive power)
Program.	17	Counts	$3*V_n * 1.2 * 6$	S (Apparent power)
Program.	18	Counts	70	Frequency
Program.	19	Counts	70	Syncrocheck Frequency
Program.	20	Counts	0.3	INS module
Program.	21	Counts	$\sqrt{3}*V_n * 1.2$	VN (neutral) module
Program.	22	Counts	0.3	Isolated Gnd module
Program.	23	Counts	100 (º)	Unit temperature
Program.	24	Counts	1.2*In (A)	I residual module

The scale range indicated corresponds to the count number 4095.

(1) Up to firmware version D the positions of these measurements depend on the family we are working with. If we dispose of an IT family, for example, the first measurement will be the current maximeter, the second one will be for the IA module, and the third measurement will be for the IB module and so on until completing all the measurement that family has.

(2) From firmware version E on the transmitted signals and the order in which they are transmitted can be programmed among those available. The programming is carried out through the protection console SIPCON/P.

XI.5.3 Commands

DNP_ID (2)	DNP_ID (1)	Data
	1	Activate relay 1
	2	Activate relay 2
	3	Activate relay 3
	4	Activate relay 4
	5	Activate relay 5
	6	Activate relay 6
	7	Activate relay 7
	8	Activate relay 8
	9	Activate relay 9
	10	Activate relay 10
	11	Activate relay 11
	16	Open breaker
	17	Close breaker
	18	Set recloser in service
	19	Set recloser out of service
	20	Set in LOCAL mode
	24	Activate table 1
	25	Activate table 2
	26	Activate table 3
	27	Activate table 4
	32	Initialize OPENING counter
	33	Initialize RECLOSER counter
	34	Initialize sigmaI2 Pole A
	35	Initialize sigmaI2 Pole B
	36	Initialize sigmaI2 Pole C
	48	Output 1 permanent activation
	49	Output 2 permanent activation
	50	Output 3 permanent activation
	51	Output 4 permanent activation
	52	Output 5 permanent activation
	53	Output 6 permanent activation
	54	Output 7 permanent activation
	55	Output 8 permanent activation

DNP_ID (2)	DNP_ID (1)	Data
	56	Output 9 permanent activation
	57	Output 10 permanent activation
	58	Output 11permanent activation
	64	Deactivate output 1
	65	Deactivate output 2
	66	Deactivate output 3
	67	Deactivate output 4
	68	Deactivate output 5
	69	Deactivate output 6
	70	Deactivate output 7
	71	Deactivate output 8
	72	Deactivate output 9
	73	Deactivate output 10
	74	Deactivate output 11

Up to firmware version D the commands are located in the fixed position that has been indicated.

From firmware version E on the commands to be sent and its order can be programmed.

APPENDIX XII. MODBUS RTU PROTOCOL

The communications module MODBUS RTU implemented in the protection unit allows the communication as slave station with a master position via the rear communication port (RS232, RS485 or Optical fibre).

XII.1. PROTOCOL CHARACTERISTICS

XII.1.1 Messages format

Master question:

Remote address	-	1 byte
Function code	-	1 byte
Data	-	variable number of bytes
CRC	-	2 byte

Slave answer:

Remote address	-	1 byte
Function code	-	1 byte
Data		variable number of bytes
CRC	-	2 byte

Remote address : PL300 address in respect to the Modbus protocol (range 1 to 255). Only broadcast messages are accepted (address 0) for synchronization with the function 16.

Function code : If >127 (Byte MSB at 1) means that the remote address has not fulfilled the required function and it is going to respond with an error code.

Data : Each data word is sent MSByte first, followed by LSByte.

CRC : LSByte is sent first, followed by MSByte.

CRC generator polynomy:

$$x^{16} + x^{15} + x^2 + 1$$

XII.1.2 MODBUS functions

The following functions are used within the defined by the MODBUS protocol:

03 – Read Setpoints and Actual Values

04 – Read Setpoints and Actual Values

(functions 03 and 04 are used without distinction)

05 – Execute Operation

07 – Read Device Status

08 – Loopback Test

16 – Store Multiple Setpoints

XII.1.3 Message examples

Function codes 03 and 04 – Read Setpoints and Actual Values

Reading of settings, digital status, measurements and counters.

Example :

Remote address : 01

Address : 0400 - Data : 00aa

Address : 0401 - Data : 00ff

Question ::

Description		Bytes		Example (hex)	
Remote address	-	1 byte	-	01	
Function code		1 byte	-	03	
Data address	-	2 bytes	-	03	data address
				08	
Data number	-	2 bytes	-	00	Data number (words)
				02	
CRC	-	2 bytes	-	xx	
				xx	

Answer :

Description		Bytes		Example (hex)	
Remote address	-	1 byte	-	01	
Function code	-	1 byte	-	03	
Bytes counter	-	1 byte	-	04	2 records = 4 bytes
Data1	-	2 bytes	-	00	Value in 0400
				aa	
Data2	-	2 bytes	-	00	Value in 0401
				ff	
CRC	-	2 byte	-	xx	
				xx	

Function 05 code – Execute Operation

Execute operation.

Example :

Remote address 01

Code operation : 01 (Command number 1)

Question :

Description	Bytes		Example (hex)	
Remote address	1 byte	-	01	
Function code	1 byte	-	05	
Operation code	2 byte	-	01	Command 1
		-	00	
Operation range	2 byte		ff	Execute command
		-	00	
CRC	2 byte	-	xx	
			xx	

Answer :

Description	Bytes		Example (hex)	
Remote address	1 byte	-	01	
Function code	1 byte	-	05	
Operation code	2 byte	-	01	Command 1
		-	00	
Value	2 byte	-	ff	Execute command
		-	00	
CRC	2 byte	-	xx	
			xx	

Function code 07 – Read Device Status

Reading of the protection status.

Question : :

Description	Bytes		Example (hex)
Remote address-	1 byte	-	01
Function code -	1 byte	-	07
CRC -	2 byte	-	xx
			xx

Answer :

Description	Bytes		Example (hex)
Remote address-	1 byte	-	01
Function code -	1 byte	-	03
Status -	1 byte	-	04

CRC	-	2 byte	-	xx
				xx

Function 08 code – Loopback Test

Link state test (communications).

Question :

Description		Bytes		Example (hex)
Remote address		1 byte	-	01
Function code		1 byte	-	08
Code	-	2 byte	-	00 must be 0
				00
Data	-	2 byte	-	00 must be 0
				00
CRC	-	2 byte	-	xx
				xx

Answer :

Description		Bytes		Example (hex)
Remote address	-	1 byte	-	01
Function code	-	1 byte	-	08
Code	-	2 byte	-	00 must be 0
				00
Data	-	2 byte	-	00 must be 0
				00
CRC	-	2 byte	-	xx
				xx

Function 16 code – Read Setpoints and Actual Values

Writing of protection values

Example :

Remote address: 01

Address : 1000 - Data : 0144

Address : 1001 - Data : 0255

Question:

Description		Bytes		Example (hex)	
Remote address	-	1 byte	-	01	
Function code	-	1 byte	-	10	
Data initial address	-	2 bytes	-	10	Data address
				00	
Data number	-	2 bytes	-	00	Data number (words)
				02	
Bytes counter	-	1 byte	-	04	2 registers = 4 bytes
Data1	-	2 bytes	-	01	Value in 0400
				44	
Data2	-	2 bytes	-	02	Value in 0401
				55	
CRC	-	2 bytes	-	xx	
				xx	

Answer :

Description		Bytes		Example (hex)	
Remote address	-	1 byte	-	01	
Function code	-	1 byte	-	10	
Data initial address	-	2 bytes	-	10	Data address
				00	
Data number	-	2 bytes	-	00	Data numbers (words)
				02	
CRC	-	2 bytes	-	xx	
				xx	

XII.1.4 Unit status request

It is made with function: 07 – Read Device Status

The unit status byte contains following information:

Bit 0 : Error in ADC converter

Bit 1 : Non critical error

Bit 2 : Critical error

Bit 3 : Protection in service

The same information can be obtained by reading the address 0009h.

XII.1.5 Change request of digital signals

There is a mechanism which allows collecting information of all digital signals changes along with the time instant when they occurred.

By reading the address 05000h it can be obtained the number of pending changes in the buffer.

From the address 05002h a buffer is available, where the 25 oldest unit changes can be read.

Once received a message of changes, writing the value 0 in the address 05001h the master position validates the changes sent in the message.

It is always demanded that the request comes with the initial address of the buffer of changes (05002h).

It is demanded that the number of words required is multiple of 5 (it must be read blocks of complete changes).

It can not be asked for more data than the buffer size or than the number of changes in queue (it means, if there is only one pending change, it is not possible to ask for two).

Given that the maximum number of words which can be sent in a message is 127 (limited for the field of number of bytes in 1 byte), the buffer of changes is sized to contain 25 changes.

25 changes * 5 words / change = 125 words. (250 bytes).

To know how many changes there are in a zone of changes reading it must be done a reading of the number of pending changes in the buffer through a reading of the address 05000h. In the low byte of the read register we will find the number of pending changes (which will be a number between 0 and 25) and in the byte 15 of the register it can be read the overflow indication of the changes in queue (for value 1 an overflow in the changes queue has occurred).

Afterwards, changes can be requested up to the maximum number previously indicated. To validate the changes received we must write the value 0 in the address 0501h through the function 16. This writing makes possible that the changes in the remote station are considered as sent; otherwise the remote station would consider them again as pending.

If the remote station had more changes that would be indicated in the value of the number of pending changes and the master station could request them by repeating the process.

To collect all the changes of the remote station, the process would have to continue until the reading of the pending changes indicates value 0.

Structure format of a digital change :

Changes : IDC + Binary time

IDC	:=	CP 16{IDENTIF, CHANGE}		
IDENTIF	:=	UI 10[1..10] <0..1023>		
CHANGE	:=	BS 6{Res, V, E, v, e}		
with	Res	:=	BS 2[11..12] not used (always <0>)	
	V	:=	BS 1[13] <0..1>	
		<0>	:=	Valid status
		<1>	:=	Not valid status
	E	:=	BS 1[14] <0..1>	
		<0>	:=	Status as "0" after the change
		<1>	:=	Status as "1" after the change
	v	:=	BS 1[15] <0..1>	
		<0>	:=	The validation bit V has not changed
		<1>	:=	The validation bit V has changed
	e	:=	BS 1[16] <0..1>	
		<0>	:=	The status bit E has not changed
		<1>	:=	The status bit E has changed

With these two bytes and by assigning a code for each signal, it is identified each digital signal of control which has suffered any change and which is transmitted with the control measurements, as well as what has changed in the digital signal and the status and validation after the change.

CP56Time2a:=CP56{Milliseconds, Minutes, Res1, Invalid, Hours, Res2, Summer time, Day of the month, Day of the week, Month, Res3, Year, Res4}

This binary time is defined in the section 6.8 of the document IEC 870-5-4. The day of the week corresponding to value 1 is Sunday.

The complete structure of the change has therefore the following format:

IDC	IDENFTIF					
	e	v	E	V	Reserve	IDENTIF
TIME CP56Time2a	Milliseconds (LSByte)					
	Milliseconds (MSByte)					
	IV	RES1	Minutes (6 bits)			
	SU	RES2	HOURS (5 bits)			
	DAY WEEK (3 bits)		DAY OF THE MONTH (5 bits)			
	RES3			MES (4 bits)		
	RES4	YEAR (7bits)				

XII.1.6 Data request by user map

The user map allows the non consecutive registers reading in a single message.

It has an address zone (from the address 0180h, 124 registers) and a values zone in the user map (from the address 0100h , 124 records).

In the address zone it must be written through the function 16 the addresses of those registers we wish to read.

Through the reading of the data zone it could be read the data whose addresses have been configured.

It could be read or written from any of the user map addresses, as long as the end of them is not exceeded.

It is demanded that the read addresses of the user map have associated a valid address in its address zone (this type of request is limited to the data zone: signals, Measurements and counters, addresses between the 0400 and the 0480h).

XII.1.7 Synchronization

From address 00f0h :

Address	MSB	LSB
00f0h	Milliseconds	Milliseconds
00f1h	Hours	Minutes
00f2h	Month	Day
00f3h	-	Year

The unit synchronization is made by function 16, writing on the address indicated and always the 4 words. It does not allow the partial writing of any data, the writing of the whole structure is always required.

The unit does not correct at all the received value, and that is why the central position will must take into account the delay communication channel to correct the value of the date and hour sent.

In such address it can be read as well the unit current time. It can be read any address as long as the range does not exceed over the address 00f3h.

XII.1.8 Commands execution

The commands execution can be performed in two ways. With function 05 or with function 16.

To execute a command through function 05 to the value of the field “operation code” must be sent the command number and to the field “Operation value” must be sent the value 0xff00 (Execute command).

To execute a command through function 16, the command code must be written in the command address (0080h). Only 1 register writing is accepted.

XII.1.9 Error codes

The unit can send following error codes in answer to a message:

01 - Non implemented function

02 - Illegal address in the data field (reserved address or non valid range for required operation)

03 -> Illegal data value

Causes for error code sending :

Reading function (03,04) :

More than 127 registers can not be read: 03 -> Illegal data value

Reserved or unknown initial address: 02 -> Illegal address in data field.

Number of data required exceeds the allowed range according to data type: 03 -> Illegal data value

Change request where the number of registers is not multiple of 5 or exceeds the number of changes data: 03 -> Illegal data value

Data request through user map with a non configured or illegal address: 02 -> Illegal address in data field

Writing function (16) :

- The bytes counter field does not correspond with field “registers number”: 03 -> Illegal data value
- Reserved or unknown initial address: 02 -> Illegal address in data field
- Configuration of the user map with a reserved or illegal address: 02 -> Illegal address in data field

XII.2. PARAMETERS

The following parameters can be accessible through keyboard/display:

Address of remote station : Address in respect to the protocol MODBUS/RTU.

Value between 1 and 255 (broadcast address 0 non admitted).

Baud rate : Value between 300 and 38400 bauds.

Parity : None, Odd or Even

Waiting time for the RTS activation: Waiting delay after receiving a message and before activating the RTS signal for transmission. Value between 0 and 1000 msec.

Waiting time for carrier stabilisation: Waiting delay once activated the RTS signal before transmitting the first character of the message. Value between 0 and 1000 msec.

For the case of RS485 this waiting delay is necessary and it must have a minimum value of 4 msec. Value between 0 and 1000 msec.

Waiting time to deactivation of RTS : Waiting delay after the transmission of a message and before deactivating the RTS signal. Value between 4 and 1000 msec.

XII.3. UNIT ADDRESSES MAP

Address (hex) F	Address (hex) E	Description	Range	Step	Unit	Format	Default value
		Unit identification					
0000	0000	Function (manufacturer internal code)				2 charact	"84"
0002	0002	Rated current				F04	"1"
0003	0003	Voltage				F05	"A"
0004	0004	Frequency				F06	"U"
0005	0005	Options				F07	"B0"
0007	0007	Communications				F08	"4"
0008	0008	Software version				F03	
0009	0009	Protection status				F09	
		Command address (Write Only)					
0080	0080	Command code to execute				F10	
		System date and Hour					
00F0	00F0	Milliseconds	0-59999			F11	
00F1	00F1	Hours and Minutes	0-24 / 0-59			F12	
00F2	00F2	Month and Day	0-12 / 0-31			F13	
00F3	00F3	Year	0-99			F14	
		User map					
0100	0100	User map values (124 values)					
017C	017C	User map addresses (124 values)					
		Reading zone					
0400	0400	Digital status 1				F15	
0401	0401	Digital status 2				F16	
0402	0402	Digital status 3				F17	
0403	0403	Digital status 4				F18	
0404	0404	Digital status 5				F19	
0405	0405	Digital status 6				F20	
0406	0406	Digital status reserve (10 registers)					
0440	042A	Measurement 1 (see "Measurements to control")	-4095 to 4095	1	Internal	F21	
0441	042B	Measurement 2	-4095 to 4095	1	Internal	F21	
0442	042C	Measurement 3	-4095 to 4095	1	Internal	F21	
0443	042D	Measurement 4	-4095 to 4095	1	Internal	F21	
0444	042F	Measurement 5	-4095 to 4095	1	Internal	F21	
0445	0430	Measurement 6	-4095 to 4095	1	Internal	F21	
0446	0431	Measurement 7	-4095 to 4095	1	Internal	F21	
0447	0432	Measurement 8	-4095 to 4095	1	Internal	F21	
..	..	..	..	..		..	
045C	0446	Measurements reserve		1		F21	
0540	04AA	Counter 1	0-4294967295	1		F02	
0542	04AC	Counter 2	0-4294967295	1		F02	
0544	04AF	Counter 3	0-4294967295	1		F02	
0546	04B1	Counter 4	0-4294967295	1		F02	
..		..	..	..		..	
0484	046E	Counters reserve (40 registers, 20 counters)		1		F02	
		Zone of status changes in digital signals					
05000	0500	Number of changes waiting to be sent	0 ..25			F01	
05001	0501	Validation of the sent changes (Write Only))	0			F01	
05002	0502	Digital changes reading zone (125 registers)				F22	
		Free memory zone					
057f	057f	Free				--	
HF	HF	Free				--	

Up to firmaware version D:

Measurements starting from the address 0410h will be the the same as indicated to the Procome protocol (PL70 Instruction Manual vol.1 pages 8.1 up to 8.4).

The value of the measurements sent can be found in internal units (value between –4095 and 4095). Each value will have associated a scale range which could permit obtaining the value in physical units.

For more information about the available magnitudes as well as their scale ranges consult the section : Other Functions -> Control Messages.

From firmware version E on:

The measurements found from 0410h address on will be those that have been programmed. The order in which they have been sent can also be programmed. The programming is carried out through SIPCON/P protection console. Up to 64 values are allowed.

The value of the sent measurements is locate din inner units (value can range between–4095 and 4095). Each value will have a background scale associated which allows obtaining its value in physical units.

In the same way, the digital status and the order in which they are sent can be programmed as well as the commands.

For more information about the available magnitudes as well as about their background scale, see the section: Other functions-> Control messages.

From firmware version F on

Change the addresses of measurements, counters and the change zone. As it can be seen in the table of address mapping, there are two columns:

Column *Address(hex) F* shows the addresses for the firmware versions from F on.

Column *Address(hex) E* shows the addresses for the firmware versions from E (inclusive) on.

XII.4. DATA FORMATS

Name	Format	Description
F01	16 bits without sign	Range : 0 .. 65535
F02	32 bits without sign	Range : 0 .. 4294967295
F03	16 bits	1 ascii character (value in low byte of the register)
F04	ASCII	1 ascii character (value in low byte of the register)
F05	ASCII	1 ascii character (value in low byte of the register)
F06	ASCII	1 ascii character (value in low byte of the register)
F07	ASCII	2 ascii characters (value in low byte of the register)
F08	ASCII	1 ascii character (value in low byte of the register)
F09	16 bits without sign	Compacted bit (Bit to 1 activated indication) Bit 0 : Error in ADC converter Bit 1 : Non critical error Bit 2 : Critical error Bit 3 : Protection in service Bit 4 to 15 : Non used
F10	16 bits without sign	Value : Associated command 0 : Command 0 1 : Command 1 ... n : Command n
F11	16 bits without sign	Range : 0 .. 59999
F12	16 bits	Bit 0 to 7 : Minutes (Value between 0 and 59) Bit 8 to 15 : Hours (Value between 0 and 23)
F13	16 bits	Bit 0 to 7 : Day (Value between 1 and 31) Bit 8 to 15 : Month (Value between 1 and 12)
F14	16 bits	Bit 0 to 7 : Year (Value between 0 and 99) Bit 8 to 15 : Value 0, non used

Name	Format	Description
F15	16 bits	Compacted bit (Bit for 1 activated digital signal) Bit 0 : Digital signal 0 Bit 1 : Digital signal 1 Bit 2 : Digital signal 2 Bit 3 : Digital signal 3 Bit 4 : Digital signal 4 Bit 5 : Digital signal 5 Bit 6 : Digital signal 6 Bit 7 : Digital signal 7 Bit 8 : Digital signal 8 Bit 9 : Digital signal 9 Bit 10 : Digital signal 10 Bit 11 : Digital signal 11 Bit 12 : Digital signal 12 Bit 13 : Digital signal 13 Bit 14 : Digital signal 14 Bit 15 : Digital signal 15
F16	16 bits	Compacted bit (Bit for 1 activated digital signal) Bit 0 : Digital signal 16 Bit 1 : Digital signal 17 Bit 2 : Digital signal 18 Bit 3 : Digital signal 19 Bit 4 : Digital signal 20 Bit 5 : Digital signal 21 Bit 6 : Digital signal 22 Bit 7 : Digital signal 23 Bit 8 : Digital signal 24 Bit 9 : Digital signal 25 Bit 10 : Digital signal 26 Bit 11 : Digital signal 27 Bit 12 : Digital signal 28 Bit 13 : Digital signal 29 Bit 14 : Digital signal 30 Bit 15 : Digital signal 31
F17	16 bits	Compacted bit (Bit for 1activated digital signal) Bit 0 : Digital signal 32 Bit 1 : Digital signal 33 Bit 2 : Digital signal 34 Bit 3 : Digital signal 35 Bit 4 : Digital signal 36 Bit 5 : Digital signal 37 Bit 6 : Digital signal 38 Bit 7 : Digital signal 39 Bit 8 : Digital signal 40 Bit 9 : Digital signal 41 Bit 10 : Digital signal 42 Bit 11 : Digital signal 43 Bit 12 : Digital signal 44 Bit 13 : Digital signal 45 Bit 14 : Digital signal 46 Bit 15 : Digital signal 47
F18	16 bits	Compacted bit (Bit for 1 activated digital signal) Bit 0 : Digital signal 48 Bit 1 : Digital signal 49 Bit 2 : Digital signal 50 Bit 3 : Digital signal 51 Bit 4 : Digital signal 52 Bit 5 : Digital signal 53 Bit 6 : Digital signal 54 Bit 7 : Digital signal 55 Bit 8 : Digital signal 56 Bit 9 : Digital signal 57 Bit 10 : Digital signal 58 Bit 11 : Digital signal 59 Bit 12 : Digital signal 60 Bit 13 : Digital signal 61 Bit 14 : Digital signal 62 Bit 15 : Digital signal 63

Name	Format	Description
F19	16 bits	Compacted bit (Bit for 1 activated digital signal) Bit 0 : Digital signal 64 Bit 1 : Digital signal 65 Bit 2 : Digital signal 66 Bit 3 : Digital signal 67 Bit 4 : Digital signal 68 Bit 5 : Digital signal 69 Bit 6 : Digital signal 70 Bit 7 : Digital signal 71 Bit 8 : Digital signal 72 Bit 9 : Digital signal 73 Bit 10 : Digital signal 74 Bit 11 : Digital signal 75 Bit 12 : Digital signal 76 Bit 13 : Digital signal 77 Bit 14 : Digital signal 78 Bit 15 : Digital signal 79
F20	16 bits	Compacted bit (Bit for 1 activated digital signal) Bit 0 : Digital signal 80 Bit 1 : Digital signal 81 Bit 2 : Digital signal 82 Bit 3 : Digital signal 83 Bit 4 : Digital signal 84 Bit 5 : Digital signal 85 Bit 6 : Digital signal 86 Bit 7 : Digital signal 87 Bit 8 : Digital signal 88 Bit 9 : Digital signal 89 Bit 10 : Digital signal 90 Bit 11 : Digital signal 91 Bit 12 : Digital signal 92 Bit 13 : Digital signal 93 Bit 14 : Digital signal 94 Bit 15 : Digital signal 95
F21	16 bits	Analogical value (value in internal units) MEA:=CP 16{OV, ER, Res, VALUE, S} with OV:=BS 1[1] not used always <0> ER:=BS 1[2] <0..1> <0>:=VALUE valid <1>:=VALUE not valid Res:=BS 1[3] not used (always <0>) VALUE:= F 12[4..15] <0..+1-2^{-12}> S:=BS 1[16] <0>:=VALUE positive <1>:=VALUE negative The overflow bit (Overflow, OV) is not used and is set to "0". In the event of VALUE overflow this is set to its maximum positive value, 4095. The maximum VALUE can be either 1.2 or 2.4 times the nominal value.

Name	Format	Description
F22	80 bits	Digital change structure (5 words) IDC + Binary time Byte 0..1: Change identifier IDC:=CP 16{IDENTIF, CHANGE} IDENTIF:=UI 10[1..10] <0..1023> CHANGE:=BS 6{Res, V, E, v, e} with Res:= BS 2[11..12] not used (always <0>) V:= BS 1[13] <0..1> <0> := Valid state <1> := Non-valid state E:= BS 1[14] <0..1> <0> := State at "0" after the change <1> := State at "1" after the change v:= BS 1[15] <0..1> <0> := Validation bit V has not changed <1> := Validation bit V has changed e:= BS 1[16] <0..1> <0> := State bit E has not changed <1> := State bit E has changed Byte 2..8: Binary time in 7 octets. CP56Time2a:=CP 56{Milliseconds, Minutes, Res1, Invalid, Hours, Res2,Summer schedule, Day of the month, Day of the week, Month, Res3, Year, Res4} Byte 9 : Not used (For more details consult the section about request of digital signal changes)

APPENDIX XIII. IEC 60870-5-103 PROTOCOL

The IEC870-5-103 communication module, implemented within the unit, allows the communication, as a slave station, with a master position through the communication rear connector (RS232, RS485 or Optical Fibre)

XIII.1. 870-5-103 COMMUNICATION PROTOCOL FUNCTION

The module implements the communication protocol based on the IEC60870-5-103 in order to communicate with a primary centre which has the IEC60870-5-103 protocol implemented. Its aim consists of collecting disturbance recorders, protection signals and measurements as well as receiving orders and commands.

The transmission and reception mesh format are set to the FT1.2 mesh format defined in the section 6.2.4.2. of standard IEC 870-5-1.

The format per character is:

1 start. bit

8 information. bits

1 parity bit, selectable between without parity or even parity.

1 stop bit, selectable between 1, and 2 stop bit

The baud rate will be selected among 600,1200, 2400, 4800, 9600, 19200 and 38400.

The communication is carried through the communication rear (RS232, RS485 or Optical Fibre).

In the same way the following functions are implemented:

Initialization.

Clock synchronization

General question

General commands.

Perturbation data transmission

The implemented functions are explained in the document IEC870-5-103 (Draft of FDIS 28.02.97). The application layer is based on the international standards IEC 870-5-3 (General structure of application data), IEC 870-5-4 (Definition and codification of application information elements), IEC 870-5-5 (Application basic functions).

The basic ASDUS implemented are described in the document IEC870-5-103 and they are the following ones:

ASDUs Compatible in Secondary to Primary direction:

<1> Message with time label.

<2> Message with time label and relative time.

<5> Identification.

<6> Clock synchronization

<8> General question end

<9> Measurements II. With variable measurement number

<23> List of stored perturbations

<26> List of stored perturbations

<27> List of stored perturbations

<28> Ready for digital signal transmission

<29> Digital signal transmission

<30> Transmission of perturbation values

<31> Transmission end

ASDUs Compatible in Primary to Secondary Direction

<6> Clock synchronization

<7> General question start

<20> General commands

<24> Transmission of perturbation data order.

<25> Transmission of perturbation data acknowledge

XIII.2. SETTINGS

Associate text	Meaning
UCL ADDRESS	It allows the identification of the remote station number. Value between 0 and 254. Default value 1.
BAUD RATE	This word- type parameter allows fixing the baud rate: 600 – 1200 – 2400 – 4800 – 9600 – 19200 - 38400) bauds. Default value 9600
PARITY	It allows selecting the type of parity to be used in the transmission. Even, odd or without parity Advisable default value is even, as shown in IEC 60870-5-103 protocol.
STOP BITS	It allows the selection of stop bits. 1 or 2 stop bits. Advisable default value is 1 stop bit as shown in IEC 60870-5-103 protocol
RTS ACT TIME	RTS. activation waiting time. Waiting timing after receiving the message and before activating the RTS signal for the transmission. Value between 0 and 2000(milliseconds).
CARRIER TIME.	Carrier stabilization waiting time. Waiting timing once the RTS signal is activated and before transmitting the message first character. Value between 0 and 2000(milliseconds).
RTS DEACT TIME	RTS. deactivation waiting time. Waiting timing after transmitting the message and before deactivating the RTS signal. Value between 0 and 2000(milliseconds).
SENDING FORMAT	Sending format: Compatible or extended. 0->compatible VDEW. 1->Private extended range. In compatible format: Only control signals configured as compatible are sent Only three measurements are sent in the measurement ASDU Only command configured as compatible are accepted

For the correct operating of the perturbation data request function , it must be connected with the Procome console through the front port and in the 'Oscillo Configuration' screen, in the section 'OSCILLO COMMUNICATION MODE', the section between the following data is allowed:

-->25.

-->maximum

25 must be selected

XIII.3. CONTROL SIGNALS

The control signals are shown in the table below:

PROCOME SIGNAL	TYP	INF	GI	INVERTED
0	135	1	1	0
1	135	2	1	0
2	135	3	1	0
3	135	4	1	0
4	135	5	1	0
5	135	6	1	0
6	135	7	1	0
7	135	8	1	0
8	135	9	1	0
9	135	10	1	0
10	135	11	1	0
11	135	12	1	0
12	135	13	1	0
13	135	14	1	0
14	135	15	1	0
15	135	16	1	0
16	160	91	1	0
17	160	93	1	0
18	135	17	1	0
19	135	18	1	0
20	135	19	1	0
21	135	20	1	0
22	135	21	1	0
23	135	22	1	0
24	160	90	1	0
25	160	92	1	0
26	135	23	1	0
27	135	24	1	0
28	135	25	1	0
29	135	26	1	0
30	135	27	1	0
31	135	28	1	0
32	135	29	1	0
33	135	30	1	0
34	135	31	1	0
35	135	32	1	0
36	135	33	1	0
37	135	34	1	0
38	135	35	1	0
39	160	85	1	0
40	0	0	0	0
41	0	0	0	0
42	135	36	1	0
43	135	37	1	0

PROCOME SIGNAL	TYP	INF	GI	INVERTED
44	135	38	1	0
45	135	39	1	0
46	135	40	1	0
47	135	41	1	0
48	135	42	1	0
49	135	43	1	0
50	135	44	1	0
51	135	45	1	0
52	135	46	1	0
53	135	47	1	0
54	135	48	1	0
55	135	49	1	0
56	135	50	1	0
57	135	51	1	0
58	135	52	1	0
59	135	53	1	0
60	135	54	1	0
61	135	55	1	0
62	135	56	1	0
63	135	57	1	0
64	160	18	1	0
65	160	16	1	0
66	135	58	1	0
67	135	59	1	0
68	135	60	1	0
69	135	61	1	0
70	135	62	1	0
71	135	63	1	0
72	135	64	1	0
73	135	65	1	0
74	135	66	1	0
75	135	67	1	0
76	135	68	1	0
77	135	69	1	0
78	135	70	1	0
79	135	71	1	0
80	135	72	1	0
81	135	73	1	0
82	135	74	1	0
83	135	75	1	0
84	135	76	1	0
85	135	77	1	0
86	135	78	1	0
87	135	79	1	0
88	135	80	1	0
89	135	81	1	0
90	135	82	1	0
91	135	83	1	0
92	135	84	1	0

PROCOME SIGNAL	TYP	INF	GI	INVERTED
93	135	85	1	0
94	135	86	1	0
95	135	87	1	0
96	135	88	1	0
97	135	89	1	0
98	135	90	1	0
99	135	91	1	0
100	135	92	1	0
101	135	93	1	0
102	135	94	1	0
103	135	95	1	0
104	135	96	1	0
105	135	97	1	0
106	135	98	1	0
107	0	0	0	0
108	136	31	1	0
109	136	32	1	0
110	135	99	1	0
111	135	100	1	0
112	135	101	1	0
113	135	102	1	0
114	135	103	1	0
115	135	104	1	0
116	135	105	1	0
117	135	106	1	0
118	135	107	1	0
119	135	108	1	0
120	135	109	1	0
121	135	110	1	0
122	135	111	1	0
123	135	112	1	0
124	135	113	1	0
125	135	114	1	0
126	135	115	1	0
127	135	116	1	0
128	135	117	1	0
129	135	118	1	0
130	135	119	1	0
131	135	120	1	0
132	160	84	1	0
133	160	68	1	0
134	135	121	1	0
135	135	122	1	0
136	135	123	1	0
137	135	124	1	0
138	160	17	1	0
139	160	36	1	0
140	135	125	1	0
141	135	126	1	0

PROCOME SIGNAL	TYP	INF	GI	INVERTED
142	135	127	1	0
143	135	128	1	0
144	135	129	1	0
145	135	130	1	0
146	135	131	1	0
147	135	132	1	0
148	135	133	1	0
149	135	134	1	0
150	135	135	1	0
151	135	136	1	0
152	135	137	1	0
153	135	138	1	0
154	135	139	1	0
155	135	140	1	0
156	135	141	1	0
157	135	142	1	0
158	135	143	1	0
159	135	144	1	0
160	135	145	1	0
161	135	146	1	0
162	135	147	1	0
163	135	148	1	0
164	135	149	1	0
165	135	150	1	0
166	135	151	1	0
167	135	152	1	0
168	135	153	1	0
169	135	154	1	0
170	135	155	1	0
171	135	156	1	0
172	135	157	1	0
173	135	158	1	0
174	135	159	1	0
175	135	160	1	0
176	0	0	0	0
177	0	0	0	0
178	0	0	0	0
179	0	0	0	0
180	0	0	0	0
181	0	0	0	0
182	0	0	0	0
183	0	0	0	0
184	135	161	1	0
185	135	162	1	0
186	135	163	1	0
187	135	164	1	0
188	135	165	1	0
189	135	166	1	0
190	135	167	1	0

PROCOME SIGNAL	TYP	INF	GI	INVERTED
191	135	168	1	0
192	135	169	1	0
193	135	170	1	0
194	135	171	1	0
195	135	172	1	0
196	135	173	1	0
197	135	174	1	0
198	0	0	0	0
199	135	175	1	0
200	135	176	1	0
201	135	177	1	0
202	135	178	1	0
203	135	179	1	0
204	135	180	1	0
205	135	181	1	0
206	135	182	1	0
207	135	183	1	0
208	135	184	1	0
209	135	185	1	0
210	135	186	1	0
211	135	187	1	0
212	135	188	1	0
213	135	189	1	0
214	135	190	1	0
215	135	191	1	0
216	135	192	1	0
217	135	193	1	0
218	135	194	1	0
219	135	195	1	0
220	135	196	1	0
221	135	197	1	0
222	135	198	1	0
223	135	199	1	0
224	135	200	1	0
225	135	201	1	0
226	0	0	0	0
227	0	0	0	0
228	135	202	1	0
229	135	203	1	0
230	0	0	0	0
231	0	0	0	0
232	135	204	1	0
233	135	205	1	0
234	0	0	0	0
235	0	0	0	0
236	0	0	0	0
237	0	0	0	0
238	0	0	0	0
239	0	0	0	0

PROCOME SIGNAL	TYP	INF	GI	INVERTED
240	135	206	1	0
241	135	207	1	0
242	135	208	1	0
243	135	209	1	0
244	135	210	1	0
245	135	211	1	0
246	135	212	1	0
247	135	213	1	0
248	0	0	0	0
249	0	0	0	0
250	135	214	1	0
251	135	215	1	0
252	135	216	1	0
253	135	217	1	0
254	135	218	1	0
255	135	219	1	0
256	135	220	1	0
257	135	221	1	0
258	135	222	1	0
259	135	223	1	0
260	135	224	1	0
261	135	225	1	0
262	135	226	1	0
263	135	227	1	0
264	135	228	1	0
265	135	229	1	0
266	135	230	1	0
267	135	231	1	0
268	135	232	1	0
269	135	233	1	0
270	135	234	1	0
271	135	235	1	0
272	135	236	1	0
273	135	237	1	0
274	135	238	1	0
275	135	239	1	0
276	135	240	1	0
277	135	241	1	0
278	135	242	1	0
279	135	243	1	0
280	135	244	1	0
281	135	245	1	0
282	135	246	1	0
283	135	247	1	0
284	0	0	0	0
285	0	0	0	0
286	0	0	0	0
287	0	0	0	0
288	135	248	1	0

PROCOME SIGNAL	TYP	INF	GI	INVERTED
289	135	249	1	0
290	135	250	1	0
291	136	1	1	0
292	136	2	1	0
293	136	3	1	0
294	136	4	1	0
295	136	5	1	0
296	136	6	1	0
297	160	23	1	0
298	160	24	1	0
299	160	25	1	0
300	160	26	1	0
301	136	7	1	0
302	0	0	0	0
303	0	0	0	0

PROCOME SIGNAL: It indicates the corresponding Procome signal number (see list of Procome signals in order to identify each signal) among those of the unit.

TYP: Function Type.

INF: Information Number.

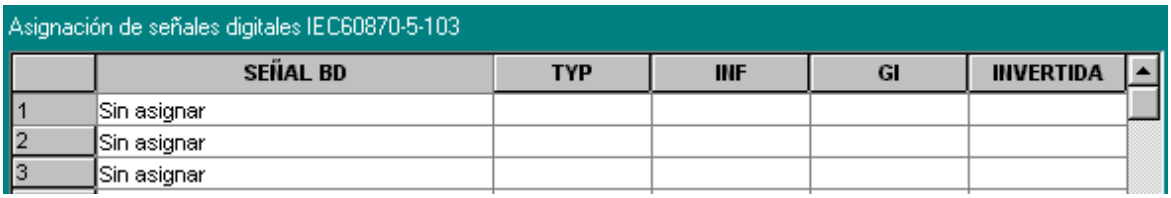
GI: It indicates if the signal is included in the response to a general question. If this option is not selected, the changes generated by the signals are only of activation.

INVERTED: It inverts the signal states.

Warning :

Up to firmaware version D, the order of the signals is the one shown in the previous table.

From firmaware version E on, the control signals can be configured according to the console screen:



BD SIGNAL: It allows the selection of the control signal among those existing in the unit.

TYP: Function Type.

INF: Information Number.

GI: It indicates if the signal is included in the response to a general question. i.e. this option ios not selected, the changes generated by the signal are only activation changes.

REVERSE: It reverses the state of a signal.

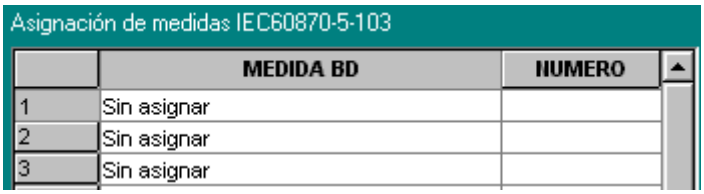
XIII.4. CONTROL ANALOGUE MEASUREMENTS

Up to firmaware version D, the control analogue measurements are sent in the same order as those sent in the Procome protocol with the following private profile:

FUN: 150

INF: 135

From firmaware version E on, the analogue measurements can be configured according to the console screen:



BD MEASUREMENT: it allows selecting a measurement from the data base.

NUMBER: It indicates the position of the measurements in the ASDU.

This table is only valid when the setting SENDING FORMAT is in EXTENDED.

XIII.5. COMMANDS

Up to firmware version D, the commands are fixed accordig to the following table:

Order	TYP	INF	DCO
Open breaker	130	12	2
Close breaker	130	13	2
Recloser ON	160	16	2
Recloser OFF	160	16	1
Remote state	160	17	2
Local state	160	17	1
Relay in service	160	18	2
Relay out of service	160	18	1
LED reset	160	19	2
Activation Table 1	160	23	2
Activation Table 2	160	24	2
Activation Table 3	160	25	2
Activation Table 4	160	26	2
Activation Output 1	130	1	2
Activation Output 2	130	2	2
Activation Output 3	130	3	2
Activation Output 4	130	4	2
Activation Output 5	130	5	2
Activation Output 6	130	6	2
Activation Output 7	130	7	2
Activation Output 8	130	8	2
Activation Output 9	130	9	2
Activation Output 10	130	10	2
Activation Output 11	130	11	2

Order: Action to carry out

TYP: Function Type.

INF: Information Number.

- DCO: Allows selecting between On and Off

From firmware version E on, the commands can be configured according to the console screen:

Asignación de órdenes IEC60870-5-103

	ORDEN BD	TYP	INF	DCO
1	Sin asignar			
2	Sin asignar			
3	Sin asignar			
4	Sin asignar			

BD ORDER: Allows selecting an order of the BD

TYP: Function Type.

INF: Information Number.

DCO: Allows selecting between On and Off

APPENDIX XIV. GESTEL PROTOCOL

Gestel communication module implemented in the protection unit (only in SC and CT families) allows the communication as slave station with a master centre through the independent rear communication connector (COM-1).

The unit disposes of some setting in order to configure this communication.

Setting	Min.	Max.	Step	Notes
Remote number	1	255	1	
Baud rate	600	9600	discrete	bauds
Parity				NO/TORQUE/ODD
CTS (hund. second)	0	500	1	
Channel type				NORMAL/(RTC-GSM)
Carrier activ. T. (hund. second)	0	500	1	
Delta 1 hund. second)	0	500	1	
Delta 4 hund. second)	0	500	1	
Logic address E.R.	1	255	1	
Alarm priority E.R.				YES/NO
Alarm priority E.R. when starting				YES/NO
No. of changes of signal	2	100	1	
No. of changes of signal reactivat.	1	100	1	

Where:

CTS is the maximum waiting time to the CTS activation, from the activation of RTS and before cancelling the message transmission.

Carrier activation time is the timing of the carrier from the moment the RTS is activated until transmission starts in hundredths of seconds.(0<= <=500).

It is not taken into account in the case of GSM transmission.

Delta 1 is the waiting time after the reception of the last character and before activating the RTS, in hundredths of seconds.(0<= <=500).

The following values are recommended depending on the baud rate:

600 bauds - 4 hundredth of sec.

1200 bauds - 3 hundredth of sec.

2400, 4800 and 9600 bauds - 2 hundredth of sec.

It is not taken into account in the case of communication via GSM..

Delta 4 is the waiting time after the reception of the last character and before activating the RTS, in hundredths of seconds.(0<= <=500).

The following values are recommended depending on the baud rate:

600 bauds - 4 hundredth of sec.

1200 bauds - 3 hundredth of sec.

2400, 4800 and 9600 bauds - bauds - 2 hundredth of sec.

It is not taken into account in the case of communication via GSM.

Remote state logic address: It can be equal or different to the remote number setting. It is used for the message treatment PET_ALARMS_GROUP.

Alarm Priority in the remote station. At NO it shows that the PET_ALARMS_GROUP message is never treated. AT YES, it shows the possibility of treating it according to the PAG control state of group alarm response that can be activated or deactivated from the centre.

Alarm priority in the remote station when starting. (NO/YES).

It is only taken into account if the alarm priority in remote station is YES. If it is at NO, it indicates that when starting, the functionality of response to the alarm message of group is deactivated. At YES it indicates that when starting the functionality of response to the alarm message of group is activated.

The 3 following settings standardize the signal activation/deactivation logic:

Activation/deactivation time span (signals).

Number of signal deactivation changes

Number of signal reactivation changes

The logic operation is as follows:

If, during the set "time span", a signal carries out a number of changes equal or higher than the programmed "number of signal deactivation changes", this signal changes into the state defined in the Gestel protocol as "Inhibited Alarm".

If, during a set "time span", the number of changes carried out by the deactivated signal is equal or lower than the programmed "number of signal reactivation changes", this signal is reactivated (changes from the "Inhibited Alarm" state to its real state) at the end of this "time span".

If it is the case that, in a deactivated signal, the number of changes carried out by this signal is higher than the set one in the "number of changes of signal reactivation" the signal keeps active.

Besides, there are some settings for the communication via modem:

Setting	Min	Max	Step	Notes
Modem configuration chain				Maximum 30 characters
First telephone number				Maximum 30 characters
Second telephone number				Maximum 30 characters
Waiting time alarm gen. (hsec.)	0	500	1	
Connection max stable T. (hsec.)	0	500	1	
Wait. max T. after hanging up RTU(hsec)	0	500	1	
N1 retry T. after N2 (min.)	0	500	1	
Modem silence inc. T. (min.)	0	500	1	
Spont. break existence				M/E – M/M
Control master channel initial st.				

Below the functionality of these settings is explained.:

Modem configuration chain: Example: AT B0 E0 Q0 X1 V1.

It admits up to 30 alphanumerical characters, and the chain must finish with the character '.'.

First telephone number call chain.

It admits up to 30 alphanumerical characters, and the chain must finish with the character '.'.

First telephone number to phone in case of changes / Alarms in the signals configured for that purpose. Example of chain that would go in the parameter N1: ATDP0,915556677. 0 is used to be able to phone through a switchboard by carrying out a pause and the `P` in order to call by pulses.

Second telephone number call chain.

It admits up to 30 alphanumerical characters, and the chain must finish with the character '.'.

Second telephone number to phone in case of failure in the connection through the first one. The attempt of this call will be always after an unsuccessful connection in N1. Example of N2 chain: ATDT44432 where `T` is used in order to dial he tones and the 44432 is an internal number of the switchboard.

Time from the moment the change/alarm is generated in the remote station up to the call is carried out (N1 or N2 sending to the modem) in hundredths of seconds. (i.e.. 200 hund. Sec.).

Maximum time for connection set up in seconds, that is, the time elapsing from the moment the call is carried out to the moment the modem sends a successful connection (i.e. 45 seconds).

Waiting maximum time before hanging up the RTU in seconds, that is, the time elapsing once the connection is set up without no message interchanging between the SCADA and the Remote. (i.e. 25 seconds).

Time of reattempts to phone N1 once the previous attempt over N1 and N2 has failed. Time in minutes. (i.e. 4 minutes).

Silence increasing time before resending the configuration to the modem from the moment nothing is received by the modem, that is, the time to wait until reconfiguring the modem, because it may have had some problems (loss of configuration, off, on, etc). For a correct operation, the value of this time must be approximately 2***Time from the moment the change/alarm is generated in the remote station up to the call is carried out* + the highest value of *Time of reattempts to phone N1* or *Maximum time of connection set up*. It must be that way in order not to configure the modem when a call is being carried out and that at least one reattempt has been carried out. Time in minutes. (i.e. 10 minutes).

Spontaneous breaking existence or Master/ Master protocol, that is, if the remote behaves like a M/M or like a M/E.

Initial state of the Master Control channel or of spontaneous breaking, that is when the control channel is active (I2 at value 1) and the previous parameter is defined as M/M, the remote will carry out the calls as long as the signal suffers the change or the alarm is configured for that purpose. Otherwise, (I2 at value 0) calls will not be carried out.

XIV.1. TYPICAL VALUES FOR THE COMMUNICATION VIA GSM

Below there is a presentation with the communication setting with which the units leave the factory. These settings are right for the remote communication via GSM modem.

Setting	Value
Remote number	230
Baud rate	2400 bauds
Parity	NO
CTS (hund. second)	12
Channel type	RTC-GSM
Carrier activ. T. (hund. second)	0
Delta 1 hund. second)	0
Delta 4 hund. second)	0
Logic address E.R.	1
Alarm priority E.R.	NO
Alarm priority E.R. when starting	NO
Modem configuration chain	AT B0 E0 Q0 X1 V1.
First telephone number	ATDP44222.
Second telephone number	ATDP44515.
Waiting time alarm gen. (hsec.)	200
Connection max stable T. (hsec.)	45
Waiting max T. after hanging up RTU	25
N1 retry after N2 T. (min.)	4
Modem silence inc. T. (min.)	10
Spont. break existence	M/M
Control master channel initial st.	If M/M it calls

Module	Description
0	Digital inputs
3	Analogue inputs
5	Digital outputs
6	Digital outputs

SC family disposes in the way it is seen in the upper table of four data modules, one for digital inputs, another one for analogue inputs and two more for digital inputs or telecontrol commands.

Module 0 (digital input)	Point
Free	1
Free	2
Breaker locking	3
State 52	4
Local state/Telecommand	5
Voltage presence	5
Free	6
Urgent Fault	7
Fault passover detection	8
Automation	9

Module 3 (analogue inputs)	Point
Voltage	1
Current	2

Note: the current input is the mean of the two phase currents (phase A and phase C) in primary values.

Module 5 (digital outputs)	Point
Activate automations	1
Deactivate automations	2
Close	3
Open	4

Module 6 (digital outputs)	Point
Activate output 1	1
Activate output 2	2
Activate output 3	3
Activate output 4	4
Activate output 5	5
Activate output 6	6
Activate output 7	7
Activate output 8	8
Activate output 9	9
Activate output 10	10
Activate output 11	11

Note: the point numeration starts in 1 ends in 16 for each module.

From firmware version E on, the tables of signals, measurements and orders can be configured through the SIPCON/P protection console.

APPENDIX XV. PID1 PROTOCOL

Gestel communication module implemented in the protection unit (only in SC and CT families) allows the communication as slave station with a master centre through the independent rear communication connector (COM-1).

The unit disposes of some setting in order to configure this communication.

Setting	Min.	Max.	Step	Notes
Remote number	1	255	1	
Baud rate	600	9600	discrete	bauds
Parity				NO/TORQUE/ODD
CTS (hund. second)	0	500	1	
Channel type				NORMAL/(RTC-GSM)
Carrier activ. T. (hund. second)	0	500	1	
Delta 1 hund. second)	0	500	1	
Delta 4 hund. second)	0	500	1	
Meas. Change level	7	4095	1	
Line silence .activ T (sec)	120	300	1	
Change general request				YES/NO
Reliability signal address	0	1024	1	
Reliability signal change T.(min.)	0	1500	1	
Synchron. permis. central center				YES/NO

Where:

CTS is the maximum waiting time to the CTS activation, from the activation of RTS and before cancelling the message transmission.

Carrier activation time is the timing of the carrier from the moment the RTS is activated until transmission starts in hundredths of seconds.(0<= <=500).

It is not taken into account in the case of GSM transmission.

Delta 1 is the waiting time after the reception of the last character and before activating the RTS, in hundredths of seconds.(0<= <=500).

The following values are recommended depending on the baud rate:

600 bauds - 4 hundredth of sec.

1200 bauds - 3 hundredth of sec.

2400,4800 and 9600 bauds - 2 hundredth of sec.

It is not taken into account in the case of communication via GSM..

Delta 4 is the waiting time after the reception of the last character and before activating the RTS, in hundredths of seconds.(0<= <=500).

The following values are recommended depending on the baud rate:

600 bauds - 4 hundredth of sec.

1200 bauds - 3 hundredth of sec.

2400, 4800 and 9600 bauds - bauds - 2 hundredth of sec.

It is not taken into account in the case of communication via GSM.

Measurement change level.

If the measurement suffers a change higher than this parameter value, it is registered as measurement change.

Change general request.

It shows that the change general request is used or not-

Reliability signal address

Parameter indicating the reliability signal address.

Reliability signal change time.

Parameter indicating how often (in minutes) a change in the reliability signal is sent. At a value zero no change is sent.

Synchronization permission central centre.

It allows or it inhibits the time synchronization from telecommand.

Besides, there are some settings for the communication via modem:

Setting	Min	Max	Step	Notes
Modem configuration chain				Max. 30 characters
First telephone number				Max. 30 characters
Second telephone number				Max. 30 characters
Waiting time alarm gen. (hsec.)	0	3000	1	
Connection max stable T. (hsec.)	0	500	1	
Waiting max T. after hanging up RTU	0	500	1	
N1 retry after N2 T. (min.)	0	500	1	
Modem silence inc. T. (min.)	0	500	1	
Spont. Break existence				M/E – M/M
Control master channel initial st				
Tiempo máximo de llamada (min.)	1	1440	1	
No. or retries change request	0	10	1	
Change request waiting T. (sec.)				
Min. T between change requests (sec.)				

Below the functionality of these settings is explained:

Modem configuration chain. Example: AT B0 E0 Q0 X1 V1.

It admits up to 30 alphanumerical characters, the chain must be finished with the character '.'.

First telephone number call chain.

It admits up to 30 alphanumerical characters, the chain must be finished with the character '.'.

First telephone number to phone in case of changes / Alarms in the signals configured for that purpose. Example of chain that would go in the parameter N1: ATDP0,915556677. 0, is used to be able to phone through a switchboard by carrying out a pause and the `P` in order to call by pulses.

Second telephone number call chain.

It admits up to 30 alphanumerical characters, and the chain must finish with the character '.'.

First telephone number to phone in case of failure in the connection through the first one. The attempt of this call will be always after an unsuccessful connection in N1. Example of N2 chain:ATDT44432 where `T` is used in order to dial he tones and the 44432 is an internal number of the switchboard.

Time from the moment the change/alarm is generated in the remote station up to the call is carried out (N1 or N2 sending to the modem) in hundredths of seconds. (i.e.. 200 hund. Sec.).

Maximum time for connection set up in seconds, that is, the time elapsing from the moment the call is carried out to the moment the modem sends a successful connection (i.e. 45 seconds).

Waiting maximum time before hanging up the RTU in seconds, that is, the time elapsing once the connection is set up without no message interchanging between the SCADA and the Remote. (i.e. 25 seconds).

Time of reattempts to phone N1 once the previous attempt over N1 and N2 has failed. Time in minutes. (i.e. 4 minutes).

Silence increasing time before resending the configuration to the modem from the moment nothing is received by the modem, that is, the time to wait until reconfiguring the modem, because it may have had some problems (loss of configuration, off, on, etc). For a correct operation, the value of this time must be approximately 2***Time from the moment the change/alarm is generated in the remote station up to the call is carried out* + the highest value of *Time of reattempts to phone N1* or *Maximum time of connection set up*. It must be that way in order not to configure the modem when a call is being carried out and that at least one reattempt has been carried out. Time in minutes. (i.e. 10 minutes).

Spontaneous breaking existence or Master/ Master protocol, that is, if the remote behaves like a M/M or like a M/E.

Initial state of the Master Control channel or of spontaneous breaking, that is when the control channel is active (I2 at value 1) and the previous parameter is defined as M/M, the remote will carry out the calls as long as the signal suffers the change or the alarm is configured for that purpose. Otherwise, (I2 at value 0) calls will not be carried out.

Call maximum time. Parameter indicating the maximum duration of the call (in minutes).

Number of attempts of change request. Number of attempts of the request for change demand.

Waiting time for change requests. Waiting time in seconds for the change demand from the Central Centre after having sent the change demand request, before carrying out a new request (attempt).

Minimum time between change requests. Minimum time in seconds between the change demand request, when the previous request, after the attempts specified in "*Number of attempts of change request",* has not been attended by the Central centre.

XV.1. RECOMMENDED VALUES FOR TYPICAL CONFIGURATIONS

Below there are two possible typical configurations of the settings of PID1 protocol. First configuration refers to a communication via radio or direct to the Central Centre and the second one to a remote communication via telephone.

The unit leaves the factory with the settings referred to the communication master-slave via telephone.

XV.2. MASTER-SLAVE COMMUNICATION VIA NON-TELEPHONE

Setting	Value
Remote number	230
Baud rate	1200
Parity	ODD
CTS (hund. second)	0
Channel type	NORMAL
Carrier activ. T. (hund. second)	1
Delta 1 hund. second)	1
Delta 4 hund. second)	2
Meas. Change level	0
Line silence .activ T (sec	120
Change general request	YES
Reliability signal address	0
Reliability signal change T.(min.)	1
Synchron. permis. Central center	YES

Setting	Value
Modem configuration chain	AT.
First telephone number	ATD77155.
Second telephone number	ATD77221.
Waiting time alarm gen. (hsec.)	3000
Connection max stable T. (hsec.)	60
Waiting max T. after hanging up RTU	60
N1 retry after N2 T. (min.)	4
Modem silence inc. T. (min.)	25
Spont. Break existence	M/E
Control master channel initial st	M/E
Call max. time (min.)	6
No. or retries change request	1
Change request waiting T. (sec.)	5
Mini. T between change requests (sec.)	20

XV.3. TELEPHONE COMMUNICATION

Setting	Master/Slave	Master/Master
Remote number	230	230
Baud rate	9600 bauds	9600 bauds
Parity	NO	NO
CTS (hund. second)	0	0
Channel type	RTC/GSM	RTC/GSM
Carrier activ. T. (hund. second)	1	1
Delta 1 hund. second)	4	4
Delta 4 hund. second)	4	4
Meas. Change level	0	0
Line silence .activ T (sec	120	120
Change general request	YES	YES
Reliability signal address	0	0
Reliability signal change T.(min.)	1	1
Synchron. permis. Central centre	YES	YES
Modem configuration chain	AT.	AT.
First telephone number	ATD77155.	ATD77155.
Second telephone number	ATD77221.	ATD77221.
Waiting time alarm gen. (hsec.)	3000	3000
Connection max stable T. (hsec.)	60	60
Waiting max T. after hanging up RTU	60	60
N1 retry after N2 T. (min.)	4	4
Modem silence inc. T. (min.)	25	25
Spont. Break existence	M/M	M/E
Control master channel initial st	M/M	M/E
Call max. time (min.)	6	6
No. or retries change request	1	1

Setting	Master/Slave	Master/Master
Change request waiting T. (sec.)	5	5
Mini. T between change requests (sec.)	20	20

XV.4. SIGNAL TABLE (PID1 PROTOCOL)

As it can be seen in tables below, the SC family disposes of digital inputs, analogue inputs apart from some commands.

Digital inputs	Point
Reserve	1
Reserve	2
Breaker locking	3
State 52	4
Local state/Telecommand	5
Voltage presence	6
Free	7
Urgent Fault	8
Fault passover detection	9
Automation	10

Analogue inputs	Point
Voltage	1
Current	2

Note: the current input is the mean of the two phase currents (phase A and phase C) in primary values.

Digital outputs	Point
Automation ON	2
Automation OFF	3
Close	4
Open	5
Activate output 1	18
Activate output 2	19
Activate output 3	20
Activate output 4	21
Activate output 5	22
Activate output 6	23
Activate output 7	24
Activate output 8	25
Activate output 9	26
Activate output 10	27
Activate output 11	28

Note: the point numeration starts in 1 ends in 16 for each module.

From firmware version E on, the tables of signals, measurements and orders can be configured through the SIPCON/P protection console.

APPENDIX XVI. SAP20 PROTOCOL

The SAP20 communication module implemented in the PL70 protection unit (SC and CT family) allows the communication as slave station with a master centre through the independent communication rear connector (COM-1).

The unit has some setting to configure this communication.

In the "Default value" column the values recommended for SAP20 communication via MODEM-RADIO are shown.

Setting	Min.	Max.	Steps	Notes	Default value
Number of the remote	1	254	1		1
Baud rate	600	9600	discretes	bauds	600
CTS (hund. second)	0	500	1		25
Carrier Act. T. (hund. second)	0	500	1		25
Delta 1 (hund. second)	0	500	1		4
Delta 4 (hund. second)	0	500	1		4
No. of changes signal deactivation	2	100	1		15
Signal Act/Deact Time Span (sec)	1	300	1		30
No. of changes signal reactivation	1	100	1		5

where:

CTS is the maximum waiting time for the CTS activation, from the RTS activation, and before anulating the message transmission.

Carrier activation time is the carrier time delay from the RTS activation until the transmission starts, in hundredths of seconds. (0<= <=500).

Delta 1: It is the waiting time after the reception the last character, before the activation of the RTS, in hundredths of seconds. (0<= <=500).

The following values are recommended regardingthe baud rate:

600 bauds - 4 Hund. seconds

1200 bauds - 3 Hund. seconds

2400,4800 and 9600 bauds - 2 Hund. seconds

In the case of communication via GSM, the followiing is not taken into account.

Delta 4 : IT is the waiting time after the reception the last character, before the deactivation of the RTS, in hundredths of seconds.(0<= <=500).

The following values are recommended according to the baud rate:

600 bauds - 4 Hund. seconds

1200 bauds - 3 Hund. seconds

2400,4800 and 9600 bauds - 2 Hund. seconds

The following three settings parameterize the activation/deactivation logic of signals:

Activation/deactivation time span (seconds).

Number of signal deactivation changes

Number of signal reactivation changes

The operation of the logic is as follows:

If during a set "time spam" a signal carries out s number of changes equal or higher than the programmed "number of signal deactivation changes", this signal changes to definite state in SAP20 protocol as "Inhibited alarm".

If during a set “time spam” the number of changes carried out by the deactive signal i s lower or equal to the programmed “number of signal reactivation changes”, the the signal changes into reactivation (change from “Inhibited alarm” state to its real state) at the end of this “time spam”.

In the case the number of changes carried out by a deactivated signal is higher tan the one set in the “number of signal reactivation changes” the signal remains deactive.

XVI.1. SIGNAL TABLE (SAP20 PROTOCOL)

SC and CT families have, as it seen in the tables showed below, digital and analogue inputs apart from some orders. So these telecontrol orders to be effective, remember that the local/telecommand input must be active so as the protections to attend the orders.

The order of the digital inputs (signals), analogue inputs as well as the digital outputs (orders) inside each module is configurable through the SIPCON console.

IMPORTANT: Enter the SAP20 number in a consecutive way and without any jump, for each type of element.

The order predefined in tne factory is as follows:

Digital inputs	POINT	PL70 RC
Local State	1	Pushbutton (L/R)
Urgent default	2	NOT DI4 or NOT DI5 or NOT DI6
Closed breaker	3	DI1
Switch onto fault	4	Internal signal
Definite trip	5	Internal signal
Recloser	6	Pushbutton r (A/M) or Command
Protection in service	7	Pushbutton (R) or Command
Breaker locking	8	DI7
Voltage presence	9	Internal signal

Analogue inputs	POINT	PL70 RC
(1)		

Note (1): The unit leaves the factory without measurements to be sentas they are not necessary in the application.

Digital outputs	Point	PL70 RC
Open/ Close (double order)	1	DO1/DO2
Recloserr (double order)	2	
Protec. in service ON/OFF(double order	3	

APPENDIX XVII. IEC-101 PROTOCOL

The 101 communication module imoplemented in the PL70 protection unit (SC and CT family) allows the communication as slave station with a central centre through the rear connector of independent communication (COM-1).

The unit has some settings to configure this communication.

In the “Default Value” settings the recommended values for IEC-101 communictaion are shown.

Communication settings	Min.	Max.	Step	Notes	Default value
RTU Address Link layer	1	65534	1		1
RTU Address Application layer	1	65534			1
Transmission factor (hund. sec)	0	1000			0
Channel type				Direct/Phone	Direct
Baud rate	600	38400	discretes	bauds	1200
Parity				NO/EVEN/ODD	EVEN
Bits Stop	1	2	discretes		1
DCD Signal Control				NO/YES	NO
RTS handling				NO/YES	NO
CTS handling				NO/YES	NO
Time delay between final TXD and RTS OFF (mseg)	0	5000	1		0
Time delay between RTS ON and TXD (mseg)	0	5000	1		0
Wait. T from RTS ON to CTS ON (mseg)	0	5000	1		0
T.between CTS ON and TXD (msc)	0	5000	1		0
T.between DCD ON and start RXD	0	1000	1		0
T.between DCD OFF and RTS ON (msg)	0	5000	1		0
Time out entre caracteres (msc)	20	200	1		100
Time span act/deac. Signal (sec)	1	300	1		10
No.signal deactivation changes	2	100	1		15
No.signal reactivation changes	1	100	1		5

Address settings	Min.	Max.	Step	Notes	Default value
IOA 1st simple state points (1)	0	65534	1		1
IOA 1º simple state points (2)	0	65534	1		5001
IOA 1º double state points	0	65534	1		10001
IOA 1º measurement points	0	65534	1		15001
IOA point full queue class 1	0	65534	1		60001
IOA point semifull queue class 1	0	65534	1		60002
IOA reliability point	0	65534	1		60004
IOA synchronised RTU point	0	65534	1		60005
IOA MM/MS mode point (dial-up)	0	65534	1		60007

Balanced mode setting	Min.	Max.	Step	Notes	Default value
Balanced mode	0	65534	1		NO
Message reattempt time (sec)	1	60	1		6
Min. time between transmissions (msc)	0	1000	1		10
Retransmission time	0	5	1		3
Period for Link-Test (sec)					600

DIAL_UP settings	Min.	Max.	Step	Notes	Default value
Operation mode when starting				MM/MS	MM
Connection maximum time (sec)	1	1200	1		2
T.without RXD connection cut (sec)	1	1200	1		2
Minimum T between accepted calls (sec)	1	180	1		60
T. between 2 consecutive call attempts (sec)	1	60	1		60
No. of call reattempts after failed connection	1	9	1		2
Repet. T. call cycle after failed connect. cycle (sec)	1	600	1		1
Max. T. of urgent data sending before MS change (sec)	1	3600	1		1
Event generation time and call start (sec.)	1	60	1		30
CONNECT reception maximum time (sec)	1	90	1		40
MODEM checking time (sec)	1	1200	1		20
Checking relay activation time (min)	1	1440	1		10
Main telephone number					
Alternative telephone number					
HAYES chain MODEM checking					

Other setteings	Min.	Max.	Step	Notes	Default value
Measurement exploration period (sec)	0	60	1		2
T. without receiving valid synchronization (min)	1	1440	1		15
Delete class-2 queue with link reset				NO/YES	SI
Size of the order buffer	1	10	1		3
Semifull value class-1 queue (%)	20	95	1		70
Semifull value class -1 queue (%)	0	80	1		30
Periodical change period (min)	1	1440	1		1440
Size of class 1 data queue	10	400	1		400
Size of class 2 data queue	10	400	1		400
No. of bytes IOA field	2	3	1		3
No. of changes signal deactivation	0	254	1		15
Point checking period activation/deactivation	1	32767	1		10
No. of changes signal activation	0	254	1		5

XVII.1. SIGNAL TABLE (IEC-101 PROTOCOL)

The digital input, analogue input and digital output tables are configured through the SIPCON/P Protection Console.

In the communication console, the screens must be set with the data base to be sent via protocol 101 to the control centre.

Digital signal configuration 101

In this table, they are included the simple signalling type signal, double signalling and bitstring, in case they exist. The following fields have to be defined:

NUMBER 101: Signal number that shows in which position the STATE buffer is going to refresh its corresponding bit. They are numbered starting from 1 up to 2048 possible signals.

For simple signals, the numbering starts in 1 and the following ones go consecutively; if there were gaps, they are not introduced.

For the events, once the word of the event state update start is given in the STATE buffer, the first value of the NUMBER field must be calculated with this word given by PO_EV.

First event: PO_EV x 16 + 1

The following ones go consecutively; if there were gaps, they are not introduced.

For double signals, the indication of open, close, undetermined and conflicting states, but as there are only two bits to show the state of a double signal, the undetermined and the conflicting state have the same numbering as the close state, refreshing the corresponding bits as 00 and 11 respectively.

This field NUMBER for the double signal is calculated from the variable PO_DP, having into account that the first double signal will have the value resulting from calculating:

PO_DP x 16 + 1, for open state

PO_DP x 16 + 2, for close, undetermined and conflicting state.

being PO_DP a word number between 0 and 127, which locates the double signals between the events and the bitstrings and it shows the word of the double signal state update start.

If in the database there are events, the operation to calculate the word of double signal Start is the following one:

PO_DP = PO_EV + (event number - 1) / 16 + 1

If there are no events, the most common case, this parameter is calculated from simple signals:

PO_DP = (simple signal number - 1) / 16 + 1

For the first Bitstring there will be 32 signals (1 for every bitstring bit) and so 32 registers with the NUMBER field.

PO_ BITS x 16 +1 ..... PO_BITS x 16 + 32

being PO_BITS a word number between 0 and 127, which locates the bitstrings as the last element to refresh in the buffer after the double signals.

In order to calculate this word, the same used for the double signals is applied. But in order to calculate what the double signal occupy, take into account that each signal needs 2 bits, so in each word only 8 double signals are refreshed.

The operation to calculate the bitstrings start word is the following:

PO_BITS = PO_DP + (numero señales dobles - 1) / 8 + 1

For this calculation take into account the size, in words, of the place the previous signals occupy in the buffer.

BD SIGNAL: It shows the signal number in the database of the PL300

NELEM: It shows the element number inside its type

For simple signals, it coincides with NUMBER field.

For events, it must go on as if they were simple signals, because internally they are treated in the same way. If, between the last simple signal and the first event, there is a step in the numbering, it has to be mentioned in this field.

For double signals, it must start in 1 again. If, in the case of double signals, some registers have been refilled with the different status of the signals, open, close undetermined and conflicting, these registers belong to the same signal, so the NELEM field must be the same for all of them.

The same happens in the case of the Bitstring, having for them 32 registers of the table with the same NELEM field.

REVERSED: It shows if the signal reversed state is waited.

TYPE: It shows the type of signal 101:

TYPE	ELEMENT TYPE
0	Simple Signalling type element
1	Double Signalling type element
2	Bitstring type element

CIN: it shows the incidence code for double signals.

CIN	INCIDENCE INTERNAL CODE
0	Change of the simple signalling value or bitstring
1	Change of signalling value to open.
2	Change of signalling value to close.
3	Change of signalling value to undetermined.
4	Change of signalling value to conflict.

Measurement configuration 101

In this table the normal, step and tap type measurements are introduced. The following fields have to be defined:

NUMBER 101: measurement number regarding the Protocol 870-5-I01. They start numbering in 1 up to 128 possible measurements. In case there are gaps in the database, those registers cannot be introduced in the table.

MEASUREMENT BD: It indicates the measurement number in the PL300 database.

DEADBAND: change magnitude in the measurement in order to be sent to the control centre. A value higher than 1% of the background is recommended.

For type 2 measurements, this field is not taken into account because any change in this kind of measurement will be sent to the control centre.

PERIOD: Time during which a change must be maintained in a signal to be sent to the control centre. It will be given in csecs.

LOW: Low limit under which a measurement will be sent to the control centre as alarm.

For type 2 measurements, this field is not taken into account because any change in this kind of measurement will be sent to the control centre.

HIGH: High limit over which a measurement will be sent to the control centre as alarm.

For type 2 measurements, this field is not taken into account because any change in this kind of measurement will be sent to the control centre.

In the limit cases, both low and high, we do not pay attention to change magnitude but to the limits of one zone. If it exceeds the given zone between the high and low limit, even if it is a very small change, it is sent to the control centre. In the same way, if it had previously been exceeded, and the measurement value has a value between the limits again.

BACKGROUND: Scale background for scaled measurements, engineering real value corresponding to the maximum value of the measurement (4095 counts).

If spontaneous changes in measurements are not desired to be sent, the LOWLIM field value are recommended to be set at their minimum value,-4095, and HIGHLIM and BTRATA at their maximum value, that is, 4095 and 8190 counts, respectively.

TYPE: Type of 101 measurement:

0 – Unidirectional measurement.- Normalized TYPE F16.

1 – Bidirectional measurement. - Stepped TIYPE I16.

The measurements in that table are set in increasing order, that is, first of all the standardized ones, and then the staggered ones.

101 order configuration

The following fields have to be defined for each order:

NUMBER 101: Information object direction (IOA) of the order in the protocol IEC 870-5-101.

ORDER BD: Order in the PL300 database

ON / OFF: ON / OFF state of the order

TYPE: type of element over which the return information is received.

0 – Simple signal

1 –Double signal

SIGNAL: Element number inside those of its type for the return information. This information is the same as the NELEM field of the signal table.

STATE: This field has a different meaning depending on the order type.

In the case of order types, it shows the end state of the signal the order is associated to, a simple or a double signal.

In the case of double orders, it shows if the state has to come reverse or not.

If the setting Command Execution Mode has Mode 6 value, the simple commands must be entered in the table as double commands, respecting the address of the information object that corresponds to them as simple commands. That is, they are entered as simple commands, but taking into account in this STATE field that they are treated as double commands.

TIMING: It shows the time, in hundredths seconds, it has to be waited until the return information associated to the order is received.

APPENDIX XVIII. IEC-104 PROTOCOL

The 104 communication module implemented in the PL70 SC unit allows communication as a slave station with a central centre through the rear Ethernet communications connector (RJ45).

The unit is equipped with a series of settings in order to configure this communication.

XVIII.1. IEC-104 PROTOCOL APPLICTION LEVEL SETTINGS

RTU AplicAddress: The AplicAddress that must appear in the *Asdu Common Address* field of the messages which are sent and received.
Minimum **1**, maximum **65534**. Default value: **65534**.

TimeOut for establishment of connection (sec) (to):
It has functionality in the master station.
Minimum: **1**, maximum: **255**. Default value: **30**.

Validation period for sent messages (sec)(t1):
Waiting time in **seconds**, as of the time that a type I message is sent until the sent message is considered as non-confirmed and the connection closes. The time period is rearmed for each type I message sent.
Minimum: **1**, maximum: **254**. Default value: **15**.

Validation period for received messages *(sec)(t2)*:
Waiting time in **seconds**, for the sending of a type S message (Supervisory), recognising the format I messages received without confirmation. This time is rearmed with the first unconfirmed message received and cancelled when the reception confirmation is sent. The value given to this timer must be inferior to the master station's t1.
Minimum: **1**, maximum: **254**. Default value: **10**.

Time period for sending test messages (sec.) (t3).
Waiting time in **seconds**, for the periodic sending of test messages (*TESTFR act*). A *TESTFR act* is also sent if, during this time, no transfers are effected between the two stations. The reception or the sending of any message, in format I, S or U, rearms this timing.
Minimum: **1**, maximum: **9999**. Default value: **20**.

Maximum number of messages transmitted without validation (k):
Number of type I messages transmitted without reception of confirmation by the control centre.
Once this limit has been reached, no type 1 messages will be transmitted until confirmation is received for at least the first message pending confirmation.
Minimum: **1**, maximum: **254**. Default value: **12**.

Maximum number of messages received without confirmation with message S (w):
Number of type I messages received before the sending of a format S message in confirmation.
If less than *w* type I messages are received, confirmation will not be sent until compliance with *t2* is met.
Minimum: **1**, maximum: **254**. Default value: **8**.

These settings are accessed through the SIPCON/P protections console, "General 101/104" screen.

The origin of the addresses of this type of object is the same as that of the IEC-101, Iberdrola profile. The settings and values are as follows:

***IOA 1st point simple statuses (1)*: 1**
***IOA 1st point double statuses*: 10001**
***IOA 1st point measurements*: 15001**

These settings are accessed through the SIPCON/P protections console, "General IEC60870-5-101" screen.

XVIII.2. TCP/IP CONFIGURATION (IEC-104 PROTOCOL)

The PL70SC's IP configuration for IEC-104 Iberdrola profile allows for the configuration of 2 IP addresses as an IEC-104 server and 8 clients to be distributed between the 2 server addresses.

In the Ibedrola profile, the only synchronization source contemplated is SNTP. Two synchronization servers, each with their own IP address, can be configured.

XVIII.2.1 General settings

Total Nº connections: Total IEC-104 clients admitted.
Minimum **0**, maximum **8**. Default value: 8.

Nº IP1 connections: Total number of IEC-104 clients corresponding to the first server, starting with the first client. The remaining clients, up to *Total number of connections*, will connect to the second IEC-104 server. Minimum **0**, maximum **8** (do not introduce more than *Total number of connections*). Default value: **4**.

IP1 Address: IP address of first IEC-104 server, corresponding to Iberdrola ***IpAddress1*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**.

IP1 subnetwork mask: IP mask for IP addresses from the first IEC-104 server's subnetwork. Admits values from **0.0.0.0** to **255.255.255.255**. There must be no dips (bits at 0 to the left or bits at 1 to the right). E.g.: for a 16 bit mask, the value should be 255.255.0.0.

Gateway IP1: IP address to which first server will employ to redirect itself to IP addresses that are not in its subnetwork. Admits values from **0.0.0.0** to **255.255.255.255**.

IP2 address: IP address of second IEC-104 server, corresponding to Iberdrola ***IpAddress2*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**.

IP2 subnetwork mask: IP mask for IP addresses from the second IEC-104 server's subnetwork. Admits values from **0.0.0.0** to **255.255.255.255**. There must be no dips (bits at 0 to the left or bits at 1 to the right). E.g.: for a 16 bit mask, the value should be 255.255.0.0.

Gateway IP2: IP address which the second server will employ to redirect itself to IP addresses that are not in its subnetwork. Admits values from **0.0.0.0** to **255.255.255.255**.

Ethernet mode: Allows selection of ***full duplex*** or ***half duplex*** modes.
Default value: ***full duplex***.

Ethernet speed: Allows selection of either ***10 megabits*** (per second) or ***100 megabits***.
Default value: ***10 megabits***.

Permission configuration:
It should be set at 0 for the IEC-104 Iberdrola profile.
Allows selection of different modes of functioning.
The 8 bits of the low byte are employed to enable connection with any client independently of the value of parameter *Total number of connections*.
The first 8 bits of the high byte enable the active refusal of connection attempts in server mode if the ESTEQ input is at value one.

These settings are accessed through the SIPCON/P protections console, "General TCP/IP Configuration" screen.

XVIII.3. IEC-104 CLIENT SETTINGS

IP address client port 1: IP address of first IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client1*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 1: Number of local listening port for the 1st connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 2: IP address of second IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client2*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 2: Number of local listening port for the 2nd connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 3: IP address of third IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client3*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 3: Number of local listening port for the 3rd connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 4: IP address of fourth IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client4*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 4: Number of local listening port for the 4th connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 5: IP address of fifth IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client5*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 5: Number of local listening port for the 5th connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 6: IP address of sixth IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client6*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 6: Number of local listening port for the 6th connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 7: IP address of seventh IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client7*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 7: Number of local listening port for the 7th connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

IP address client port 8: IP address of eighth IEC-104 client. Minimum **0**, maximum **8**, corresponding to Iberdrola ***IP_client8*** parameter. Admits values from **0.0.0.0** to **255.255.255.255**. In the case of 255.255.255.255, any client IP is admitted.

Listening port 8: Number of local listening port for the 8th connection as server.
Minimum: **0**, maximum **65534**.
It is always 2404 for IEC-104.

These settings are accessed through the SIPCON/P protections console, “TCP/IP Protocols Configuration” screen.

XVIII.4. SNTP SYNCHRONISATION SETTINGS

SNTP synchronisation permission: Enables or disables the SNTP server requests. Admits values ***Permitted*** or ***Not permitted***.
Default value: ***Permitted***.

Automatic time schedule change permission: Enables or disables the automatic summer/winter time change when the date/time configured in the ***SNTP seasonal time change dates*** table is reached. Admits values ***YES*** or ***NO***.
Default value: ***Yes.***

SNTP1 IP server (IP1_RLJEXT): Main and priority SNTP server IP address. Corresponds to Iberdrola ***IP1_RLJEXT*** parameter.
It can be the IP address of a local SNTP server. The configuration of broadcast addresses is not permitted. The value 0.0.0.0 or 255.255.255.255 means that the synchronization source is nonexistent.

Local IP with watch 1: Allows the first or second local IP address to be selected as SNTP client for requests to the main SNTP server. Admits values ***First*** or ***Second***.
Default value: ***First***

SNTP2 IP server (IP2_RLJEXT): Alternative SNTP server IP address. Corresponds to Iberdrola ***IP2_RLJEXT*** parameter.
The configuration of broadcast addresses is not permitted. The value 0.0.0.0 or 255.255.255.255 means that the synchronization source is nonexistent.

Local IP with watch 2: Allows the first or second local IP address to be selected as SNTP client for requests to the alternative SNTP server. Admits values ***First*** or ***Second***.
Default value: ***Second***

SNTP servers probe interval (min)(T_PETSINCRO):
Corresponds to Iberdrola ***T_PETSINCRO*** parameter.
Defines the interval in **minutes** of the probes sent to the defined SNTP servers in order to obtain synchronization information. This time interval is independent of the duration of the synchronization cycles, which are understood as all the requests and renewed intents effected to the main and the alternative sources. Consequently, each synchronization cycle may have a variable duration.
Two possible scenarios may result from compliance with the timed interval:
- There is no synchronization cycle underway. In this case, a new cycle is started.
- There is no synchronization cycle underway. In this case, the synchronization request is rejected. The following synchronization cycle will attempt *T_PETSINCRO* and the current synchronization cycle will terminate normally.
Minimum: **1**, maximum **1440**. Default value: ***1***.

Waiting time for response from SNTP server (sec)(T_ESPSINCRO):
Corresponds to Iberdrola ***T_ESPSINCRO*** **parameter**.
Minimum: **1**, maximum **60**. Default value: ***5***.
Waiting time for response to a unicast synchronization request made to an SNTP server. If a response is not received in T_ESPSINCRO **seconds**, a unicast request to server reattempt cycle will start. Each request will be separated by the value specified in the setting.

Nº of reattempted requests to SNTP server (N_REINT_SINCRO):
Corresponds to Iberdrola ***N_REINT_SINCRO*** **parameter**.
Minimum: **0**, maximum **9**. Default value: ***2***.
Number of reattempted unicast requests to an SNTP server in the event of no response being received. In the case of the main source, and once the reattempts have concluded, a new attempt at synchronization with the alternative source is started. In the case of reattempts with the alternative source, the synchronization attempt for this interval will terminate and a new attempt will be made in the following period. 0 represents no reattempt, a change in source upon the first error or the finalization of the probe interval.

Advance / Delay in relation to UTC:
Determines the sign representing the difference between the local time and UTC.
It is a drop-down with two options: ***Advance*** and ***Delay***. Default value: ***Advance.***

Advance / Delay hours in relation to UTC:
Difference between local time and UTC during winter time.
Minimum: **0**, maximum: **23**. Default value: ***1***.

Synchronization from the console (PROCOME) or from the keyboard/display is not permitted when at least one of the SNTP service is not in fault. **IRIG-B has preference over the rest of the synchronization functions.**

These settings are accessed via the SIPCON/P Protections console, “SNTP Configuration” screen.

XVIII.5. SIGNALS, MEASUREMENTS AND COMMANDS TABLES (IEC-104 PROTOCOL)

The digital input, analogue input and digital output command tables are configured through the SIPCON/P Protection Console.

In the communication console, the screens must be set with the data base to be sent via protocol 104 to the control centre.

Digital signal configuration 101/104

Any existing simple signalling, double signalling and bitstring signals are introduced into this table. The following fields must be defined:

NUMBER 101: Signal number indicating the STATUS buffer position in which the corresponding bit is to be refreshed. They are numbered from 1 to 128 possible signals.

For simple signals, the numbering starts in 1 and continues consecutively; any existing gaps should not be introduced.

For double signals, indication is given of open (01b), closed (10b), intermediate (00b) and undetermined (11b) states. Nevertheless, as there are only two bits to show the state of a double signal, the undetermined, physical signal A and state A (bit 1 of the binary value) and the physical signal B or state B (bit 0 of the binary value) share the same numbering as the closed state, refreshing the corresponding bits as 00 and 11, respectively.

The *NUMBER 101* field for double signals is calculated in accordance with the variable PO_DP, with the *NUMBER 101* field of the first double signal reflecting the value resultant from the calculation:

PO_DP x 16 + 1, for open state

PO_DP x 16 + 2, for closed, undetermined and conflicting state.

In which PO_DP is a word number between 0 and 7, indicating the start word for the refreshing of the double signal states.

The PO_DP variable is calculated in accordance with the simple signals:

PO_DP = (number of simple signals - 1) / 16 + 1

In order to calculate what the double signals occupy, we must bear in mind that each signal requires 2 bits and, thus, only 8 double signals are refreshed in each word.

There is currently only a double signal for the PL70 **SC** family (***52-Breaker closed***), which is timed to create an event for a change to intermediate (00b) or undetermined (11b) state, in the ***Unknown 52*** signal.
The setting for this time is available in the following screen: *General SETTINGS*
General and remote port Configuration, ***Unknown52 Stabilization Time (sec)***.
The PL70SC ***52-Breaker closed*** signal is employed in inverted form in the table with CIN = 1, and in direct form (without inversion), with CIN = 2. The signals associated to status A and status B have CIN = 5 and 6. The ***Unknown 52*** signal is calculated using the "52-Breaker A Status" and "52-Breaker B Status" input signals.

In the event of configuring a simple signal to be sent as a double signal via IEC-104, the same procome signal is to be employed in 3 positions within the table, as shown below:
For the OFF status of the double signal, use the inverted signal and CIN = 1.
For the ON status, use the direct signal and CIN = 2.
In order to count the changes for deactivation resulting from bounces, use the direct signal and CIN = 6.

BD SIGNAL: Indicates the signal number in the PL70 database. One of the available signals is selected from a drop-down menu, which contains the corresponding descriptions.

NELEM: Indicates the element number within the corresponding type

For simple signals, it coincides with the NUMBER field.

For double signals, it must start in 1 once more.
It must have the following value:
(IEC address of the object – ***IOA 1st point double status*** + 1 setting).
Within the Iberdrola profile, with the setting set at 10001, it corresponds to (IOA – 10000).
If, in the case of double signals, some registers have been completed with the different status of the signal, open, closed, undetermined and conflicting, physical signal A, physical signal B, these registers belong to the same signal. Thus, the NELEM field must be the same for all of them.

INVERTED: Indicates if the signal's inverted status is expected.

TYPE: Indicates the 101/104 signal type:

TYPE	ELEMENT TYPE
0	Simple Signal type element
1	Double Signal type element

CIN: Indicates event code

CIN	INTERNAL EVENT CODE
0	Change of value simple signal
1	Change of value double signal to open = OFF (01b).
2	Change of value double signal to closed = ON (10b).

3	Change of value signal to intermediate (00b).
4	Change of value signal to undetermined (11b).
5	Physical signal status provided by 0 (status B)
6	Physical signal status provided by 1 (status A)

These settings are accessed via the SIPCON/P Protections console, "101/104 digital signals configuration" screen.

Configuration of 101/104 measurements

The normalised measurements are introduced into this table. The following fields must be defined:

NUMBER 101: Average measurement in relation to 870-5-l01/104 protocol. Numbering is started at 1, with up to 15 possible measurements. Non-assignable. In order to provide the measurements IOA, the value is added to the ***IOA 1ST point measurements*** setting, from which 1 is subtracted. Thus, the measurements always begin in IOA 15001 for the Iberdrola profile. These measurements, furthermore, are consecutive.

MEASUREMENT BD: Indicates the measurement number in the PL70 database. One of the available measurements is selected from a drop-down menu, which contains the corresponding descriptions.

DEADBAND: The magnitude of the change in the measurement in order that it is sent to the control centre, expressed as a 1000th. A value superior to 1% of the full scale range is recommended.

PERIOD: Time during which a change must be maintained in a signal to be sent to the control centre. It will be given in hundredths of a second. It is not taken into account in this protocol. A common setting is used instead: ***Measurement exploration period (sec.)***

LOW: Lower limit, below which a measurement will be sent to the control centre as an alarm (class 1). It is not employed in this profile and the measurements are always sent as class 2.

HIGH: Upper limit, above which a measurement will be sent to the control centre as an alarm (class 1). It is not employed in this profile and the measurements are always sent as class 2.

BACKGROUND: Scale range for scaled measurements, real engineering value corresponding to the maximum value of the measurement (4095 counts). It is not employed in this profile and the measurements should be TYPE = 0 (normalized).

TYPE: Type of 104 measurement:

0 – Unidirectional measurement.- Normalized TYPE F16.

1 – Bidirectional measurement. - Stepped TYPE I16.

All the measurements in this profile should be TYPE = 0 (normalized).

These settings are accessed via the SIPCON/P Protections console, "101/104 measurements configuration" screen.

Configuration of 101/104 commands

The following fields must be defined for each command:

NUMBER 101: The command's information object address (IOA) in the IEC 870-5-101/104 protocol. Two registers with the same *NUMBER 101* field are used for double commands.

COMMAND BD: Command in the PL70 database. One of the available commands is selected from a drop-down menu, which contains the corresponding descriptions.

ON / OFF: The command's ON / OFF status. For double commands, a distinction is made between which commands are to obey the OFF (open, DCO = 1) command and which are to obey the ON (close, DCO = 2) command.

TYPE: Type of element about which the return information is received.

0 – Simple signal

1 –Double signal

SIGNAL: Element number within those of its type for the return information. This information is the same as that within the NELEM field of the signal table.

STATUS: This field has a different meaning depending on the command type.

In the case of simple commands, it indicates the final status of the signal to which the command is associated, independently of whether it is a simple or a double signal.

In the case of double commands, it indicates if the expected status should be inverted or not.

If the *Command Execution Mode* setting has a value of *Mode 6*, the simple commands must be entered in the table as double commands, respecting the information object address that corresponds to them as simple

commands. That is, they are entered as simple commands, but taking into account in this STATUS field that they are treated as double commands.

TIMING: Indicates the timing, in hundredths of a second, to be observed prior to the reception of the return information associated to the command.

These settings are accessed via the SIPCON/P Protections console, “101/104 commands configuration” screen.

APPENDIX XIX. PREVENTIVE MAINTENANCE

The self-checking constantly performed by the unit, can detect the following situations:

Critical hardware error

- Error in the converter reference voltage
- Error in the converter
- Error in the FLASH memory recording
- Error in the relays activation
- Error in the SPI communication (between micro and converter)

Non critical hardware error

- Clock synchronization error

HW error corrected

- In the event of any failure detection, the alarm will remain until the failure is disappeared. This alarm can be visualised through:

Status screen

Control events

Events

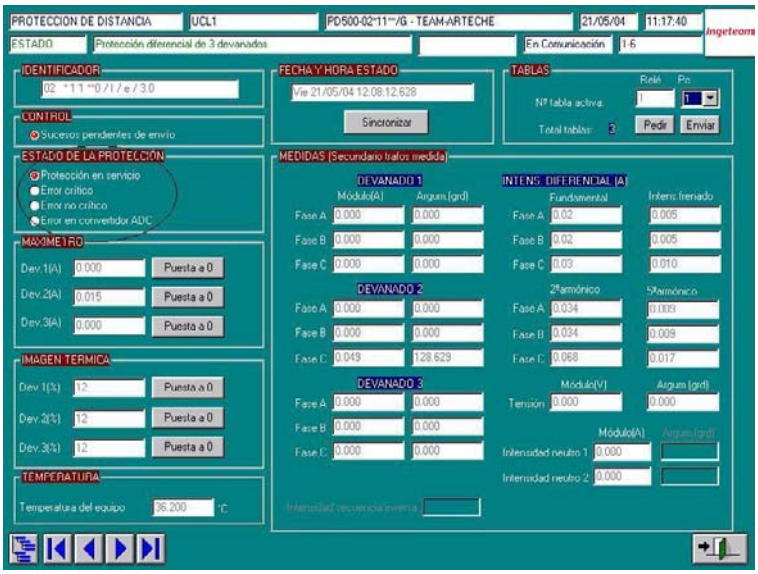
Digital outputs

Led

XIX.1. FAILURE DETECTION

The failure detection can happen in various ways .

Status screen



In the section "Protection status" (marked on the picture), we can find the situation in which is currently the protection, through three signalisations: Protection in service

- Critical error
- Non critical error
- Error in ADC converter

By normal functioning, only the signalisation (in red) for protection in service must be on. Any of the other 3 signalisations indicate an unusual situation.

Control signals

If the hardware status signal (digital signal 143 from the section "List of available signals", Appendix III) is by 0, this indicates that some unusual situation has occurred (critical error) in the unit. By 1 indicates Hardware OK.

Digital outputs

A digital output can be programmed with the signal "HW status", which will be activated by normal functioning and de-activated by critical error. If the opposite logic is desired, this can be done through the programmable logic signals.

Leds

The programmable Leds count with the same options as the digital outputs.

The non programmable bicolour Led (OK/F) indicates(when programmed "HW Status"):

Correct functioning if green

Critical error detection if red

Events

As well as indicating if the error is or not critical, the events also indicate the type of error detected and they are the ones quoted in the first part of this chapter.

XIX.2. ERROR HANDLING PROCEDURE

The procedure will depend on the detected error and the unit status.

The "HW errors corrected" event indicates that the appeared problems have been resolved.

If the unit is off, check that the power supply is correct. If the unit is well supplied, contact the technical service.

If the unit is on but shows failure, return to the events screen and check which type of error it is:

If critical error, with no specific indication, is shown and the error persists after turning the unit off and on, contact the technical service.

If converter or reference voltage error is shown. Check the Measurements, and if correct turn off and on the unit; if the error does not disappear, contact the technical service.

If Clock error is shown, synchronize manually. If the error persists, contact the technical service.

If error in the Flash memory recording is shown, send the settings again. If error persists contact the technical service.

APPENDIX XX. RECEPTION TESTS

XX.1. MATERIAL NEEDED

Three phase voltage and current generator with variable frequency of class<0.5

Chronometer unit with starting by current or voltage injection, with precision <0.001s

Wiring

Power supply of Vdc +-10% (Vdc depending on model)

XX.2. MEASUREMENTS CHECKING TESTS

The Measurement range is up to 1.2 times the nominal value (5 A). The error in that range must be less than 0.5% of the 1.2*nominal value.

The protection range error must be less than 3% of the introduced value.

The points to be tested are under the worker choice, but those below are recommended:

Current (A)
0.5
1
5 (nominal)
10
50

XX.2.1 Measurements in display

Measurements will be done by injecting voltages and currents in one phase and checking on the display that only this phase presents a non 0 value and that it is within the defined limits.

Furthermore it must be taken into account that the Measurements must appear in display in primary as well as secondary values (multiplied by the Measurement transformers ratio).

XX.2.2 Measurements in console

Measurements will be made by injecting voltages and currents in one phase and checking on the display that only this phase presents a non 0 value and that it is within the defined limits.

Furthermore it must be taken into account that in the console must appear measurement in both secondary values in the state screen and in primary values in the measurements and control screen (multiplying by the measurement transformers ratio).

If power is measured, it must be taken into account that there is a factor by which the calculated power is divided before being sent to the console (Measurements and control). Make a test for several values for this (for instances 0.1, 1 and 10).

This test must be carried out for all phases and checking the Measurements in the console.

XX.3. PROTECTION FUNCTIONS

For the reception tests, the following settings will be introduced in the relay:

Digital input configuration

DI 1	Breaker status
DI 2	Locking of the function to be tested

Digital Outputs Configuration

DO 1	General trip
DO 2	Breaker closing
DO 3	Ongoing cycle
DO 4	Definitive trip
DO 5	Phase (I) trip
DO 6	HW status

LEDs Configuration

LED 1	Timed pickup (I-V)
LED 2	Phase trip (I)
LED 3	Neutral trip
LED 4	Instantaneous trip (I-V)
LED 5	Ongoing cycle
LED 6	Definitive trip
LED 7	HW status (green OK)

XX.3.1 Hardware status

Check that if the relay is off, the output contact DO6 ("HW status") is closed. Switch on the relay and check that this contact opens.

Furthermore, when turning on the unit the led no. 7 must remain in green ("HW status")

XX.3.2 Instantaneous units (current, voltage, frequency)

This protocol applies to any instantaneous voltage and current unit the unit has. The most usual are:

Phase instantaneous overcurrent

Neutral instantaneous overcurrent (and sensitive neutral

A test unit prepared for measuring the tripping times will be used to carry out all these tests.

Disable the corresponding timed function and all the functions which are not being tested.

Pickup and dropout in the trip

Set the additional time of instantaneous to 0 seconds.

They will be tested by making rising slopes of I, V or f (depending on the tested unit) from 90% to 110% of the setting taking note of the value at which the instantaneous is picking up. By reaching the tripping point, it must remain there for a while checking that there are no drop outs but it remains tripped

Afterwards a descending slope to the drop out point will be made, taking note of this point value. The points to be checked are up to the operator but it is recommended to test the following settings:

Current (A)
6
10
20
40

Check that the digital outputs and the corresponding LEDs are activated by tripping. After each test, make a "Fault acknowledgment" to turn off the LEDs.

Speed of the instantaneous trip

It is about testing the tripping speed of the relay when tripping time is 0. Therefore, the additional time of instantaneous will be set to 0 sec.

It will be tested by applying a value higher than the starting value set (2 times for current, 1.2 times for voltage) noting down the time in which the instantaneous picks up.

To carry out this test a chronometer will be used, which will be started by the signal injection and stopped by the trip relay operation.

Suggested settings: same as the pick-up and drop-off settings.

The tripping time must be less than 50 ms.

Instantaneous trip with additional time

Same as the precedent, for different additional time settings, noting down the time in which the instantaneous trips. The error must not be higher than 5% of the programmed time or 50 ms (the highest of the two)

Function locking test

Check that once activated the programmed locking input, there are no trips in the corresponding function (this is general for any function).

XX.3.3 Timed units (current and voltage)

This protocol applies to any timed current and voltage unit. The most usual are:

Phase timed overcurrent

Neutral timed overcurrent (and sensitive neutral)

A test set prepared for measuring tripping times will be used to carry out all these tests.

Disable the corresponding instantaneous function and all the functions which are not being tested.

Pickup and dropout

The test will be carried out in a similar way to the instantaneous one. The type of trip curve will be set as definite time with a trip time of 0.

Check that the digital outputs and corresponding LEDs are activated when tripping. After each test make a "Fault acknowledgment" to switch off the LEDs.

Definite time

The test will be carried out in similar way to the instantaneous one.

Tripping times following curves

The test is carried out in the same way as for the definite time but setting the time delayed unit with all possible types of curves and different indexes shown on Appendix II, where the theoretical operating times are indicated.

The time measurements will be repeated for different points of the tripping curve and for different settings according to the operator criteria.

XX.4. CURRENT UNBALANCE UNITS

These units act when exceeding the I2 threshold (Negative sequence current)

The tests will be the same as for the phase instantaneous and timed unit unless current is injected in the three phases and with certain values.

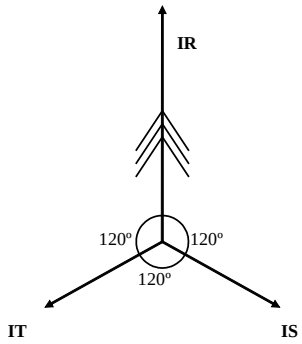
The phase protection units must be disabled.

Pickups

The instantaneous and the timed units are tested in the same way.

The tripping time must be set to a minimum (0.1sec.) and if it is a time delayed unit, the time curve is set to definite time.

Currents of the same amplitude are injected with 120º of phase difference and values according to following tables. Then the current in phase A is increased until the protection trips. Every current increase must last at least 0.1 seconds to give enough time for the protection to trip.



When it trips, the I2 trip will be calculated to see the error made in the following way

$$I2.trip\ (s)=(|IRtripl-|Ifixedl)/3$$

The test must be repeated for different Ifixed and for different settings. The following will be recommended:

I2=I negative seq. set		I fixed
1		3
2		5
4		10

Trip times

The proceeding is the same for both instantaneous and time delayed of unbalance. For timed unit the inverse time curves will be checked.

Currents of same amplitude and 120º of phase difference are injected with values as indicated in the following tables, then the time to trip the protection is measured.

XX.4.1 Broken conductor unit

Before performing this test all the phase units must be disabled.

Pickups

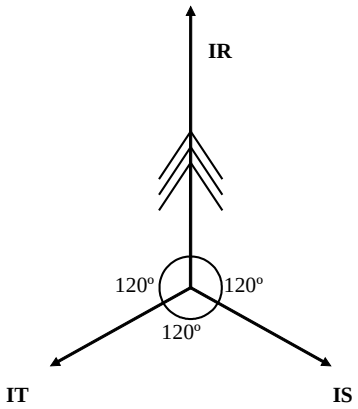
It is tested in the same way as the unbalance unit. The tripping time must be set to a minimum (0.1sec.).

Currents of the same amplitude are injected with 120º of phase difference and values according to following tables. Then the current in phase A is increased until the protection trips. Every current increase must last at least 0.1 seconds to give enough time for the protection to trip.

The test is repeated for different Ifixed:

1 A
2 A
5 A

At the end the trip error is calculated.



BROKEN CONDUCTOR UNIT

SETTING	I pickup			TRIP VALUE
	Phase R	Phases	Phase T	
I2/I1	IR(A)	IS(A)	IT(A)	I2/I1trip=(IIRIIIfixedI)/(IIRI+2·IIfixedI)
0.15		Ifixed	Ifixed	
0.2		Ifixed	Ifixed	
0.3		Ifixed	Ifixed	
0.4		Ifixed	Ifixed	
0.5		Ifixed	Ifixed	

Trip times

The proceeding is the same as for the instantaneous of unbalance.

Currents of same amplitude and 120º of phase difference are injected with values as indicated in the following tables, then the time to trip the protection is measured.

The test is repeated for different Ifixed and different settings.

XX.5. RECLOSER

It is aimed to confirm several aspects:

That for any kind of trip (with all the enabling to YES), the recloser is able to perform a complete reclosing cycle and that on each cycle state all corresponding signals are activated (outputs and leds).

That all the phase and earth fault reclosing are correctly discriminated.

That the timing to be set (dead time, reclaim time and reference voltage time) are exactly respected.

That the enabling of allowed reclosing and trips operate correctly.

In all the tests the enabling of trip after reclosing and reclosing after trip must be configured to YES.

During the reclosing tests the time to be measured is the one from the circuit breaker opening to the circuit breaker closing signal.

XX.5.1 Initial tests

Wire the breaker trip and closing outputs to a two-stable relay which performs the line circuit breaker function. In this way a voltage of 125 V must appear at the terminals of the input “Breaker status” when giving a closing order. The signal in this input must be 0 V when a trip happens.

If there is an input programmed as “Reference voltage”, it must be activated to allow reclosing.

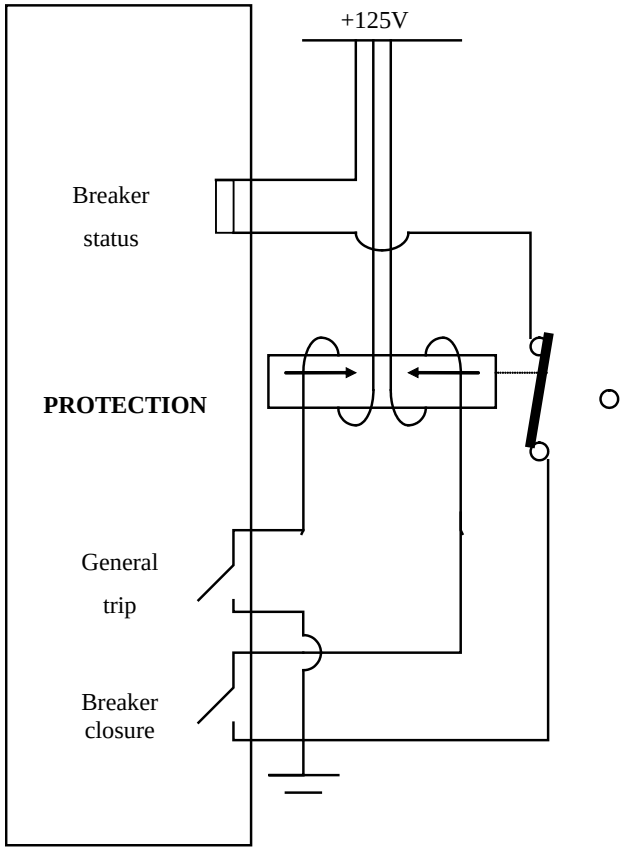


Figure 1

Before the tests:

Check that the Recloser locking, the external as well as the one of the panel, are disabled

Set all the time delay (reclosing and blocking times) with different values so that makes it easier to see the differences between them.

The reclosing times will indicate which one of the three reclosings is being performed. To measure them it will be measured the interval from the breaker opening until the breaker closing order.

Check the following by each test:

Every time a trip occurs, the ongoing cycle output must be activated and turn on the corresponding led unless a cycle of three reclosings has been performed, which will lead to Definitive trip.

When the reclosing occurs the output cancellation of instantaneous must be activated (if this was programmed) and also the corresponding led while it is on reclaim time or until another trip occurs within this reclaim time.

TRIP (D),RECLOSURE (R),NORMAL (N)

Manual closing

Wait the reclaim time after manual closing

Provoke a trip

Check that the led ongoing cycle turns on

Check that the First Reclosing occurs in the TREEN1 time.

Check that the LED of the front panel ongoing cycle turns off and that the output ongoing cycle is deactivated and the instantaneous is annulled when reclaim time is expired.

Repeat the test with instantaneous trips and time delayed trips of phase, neutral, sensitive neutral (if they exist), unbalance and broken conductor.

In case of trips by neutral or sensitive neutral the dead and reclaim times will be the earth-fault ones but for the rest of trips times must be the phase-fault ones.

D,R,D,R,N

Manual closing

Wait the reclaim time after manual closing

Provoke a trip

Check that the LED of the front panel ongoing cycle turns on

Check that the First Reclosing occurs in the TREEN1 time.

Provoke a trip before the reclaim time is expired after automatic closing

Check that the Second Reclosing occurs in the TREEN2 time.

Check that the LED of the front panel ongoing cycle turns off and the output ongoing cycle is deactivated.

Repeat the test with instantaneous trips and time delayed trips of phase, neutral, sensitive neutral, unbalance and broken conductor

D,R,D,R,D,R,N

Manual closing

Wait the reclaim time after manual closing

Provoke a trip

Check that the LED of the front panel ongoing cycle turns on

Check that the First Reclosing occurs in the TREEN1 time.

Provoke a trip before the locking time expires after an automatic closing.

Check that the Second Reclosing occurs in the time TREEN2.

Provoke a trip before the locking time expires after an automatic closing.

Check that the Third Reclosing occurs in the TREEN3 time.

Check that the LED of the front panel ongoing cycle turns off.

Repeat the test with instantaneous trips and time delayed trips of phase, neutral, sensitive neutral, unbalance and broken conductor

D,R,D,R,D,R,D,R.

Manual closing

Wait the blocking time after manual closing

Provoke a trip.

Check that the LED of the front panel ongoing cycle turns on.

Check that the First Reclosing occurs in the time TREEN1..

Provoke a trip before the locking time expires after an automatic closing.

Check that the Second Reclosing occurs in the TREEN2 time.

Provoke a trip before the blocking time expires after an automatic closing.

Check that the Third Reclosing occurs in the TREEN3 time.

Provoke a trip before the blocking time expires after an automatic closing.

Check that the Fourth Reclosing occurs in the TREEN4 time.

Check that the LED of the front panel ongoing cycle turns off.

Repeat the test with instantaneous trips and time delayed trips of phase, neutral, sensitive neutral , unbalance and broken conductor.

D,R,D,R,D,R,D,R,DISP. DEF.

Manual closing

Wait locking time after manual closing

Provoke a trip.

Check that the LED of the front panel ongoing cycle turns on.

Check that the First Reclosing occurs in the TREEN1 time.

Provoke a trip before the locking time expires after an automatic closing.

Check that the Second Reclosing occurs in the TREEN2 time.

Provoke a trip before the locking time expires after an automatic closing.

Check that the Third Reclosing occurs in the TREEN3 time.

Provoke a trip before the locking time expires after an automatic closing.

Check that the Fourth Reclosing occurs in the TREEN4 time.

Provoke a trip before the locking time expires after an automatic closing.

Check that the LED Definitive trip turns on.

Repeat the test with instantaneous trips and time delayed trips of phase, neutral, sensitive neutral unbalance, broken conductor and also by external protection.

XX.5.2 Enabling checking test

Enabling of allowed trips

It is started from all the allowed trips and one of them is disabled checking that it does not trip during the corresponding reclaim time.

A locking time of at least 10 seconds must be given which allows confirming that they are operative when the desired trip is provoked.

A table will be filled in checking that all the possibilities operate.

Trips allowed after reclosing	PHASE Instant./Timed	NEUTRAL Instantaneous /Timed	SENSITIVE NEUTRAL Instant./Timed	UNBALANCE Instant./Timed	BROKEN COND.	EXTERNAL PROTECT.
After R-1	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
After R-2	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
After R-3	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
After R-4	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
After MANUAL CLOSING	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓

Enabling of reclosings

It is started from all the reclosings as allowed and it is continued disabling some of them, checking that they do not operate after the corresponding trips.

Reclosings allowed after trip	Phase Instantaneous /Timed	NEUTRAL Instantaneous /Timed	SENSITIVE NEUTRAL Instantaneous /Timed	UNBALANCE Instantaneous/ Timed	BROKEN CONDUC TOR	EXTERNAL PROTECTION
R-1	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
R-2	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
R-3	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓
R-4	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓	YES ✓ NO✓

XX.5.3 Tests with/without reference voltage

The waiting time of the reference voltage is set to a lower value than the reclosing time.

During a reclosing cycle the Vref. is taken away and it is checked that after the waiting time set the cycle is interrupted and it moves on to definitive trip (the time to reach Definitive trip since the breaker opens is measured in order to check the correct operation of the recloser).

XX.5.4 Recloser locking test

It is checked that the recloser does not perform the reclosings when:

The external contact RECLOSER LOCKING is closed.

The number of trips is exceeded in the time set (setting "Excessive number of trips"). This parameter can be seen only in the console. In these cases the output "locked recloser" is activated and the recloser goes to the status Definitive trip and activates its corresponding signal.

It is disengaged through the push-button R.

It is disengaged through the control command.

It is disengaged through the protection command.

In the three cases the output "Locked recloser" must be activated.

XX.5.5 Time measurements

Recloser time

It is measured the time, from the breaker opening until the breaker closing command. It must coincide with the programmed time. The times to be programmed are up to the operator, but it is recommended to test the minimum and maximum allowed.

Reclaim time

It is measured the time while the output cancellation of instantaneous is activated (if it is programmed) which is coincident with the reclaim time after a reclosing. The times to be programmed are up to the operator but it is recommended to test the minimum and maximum allowed.

XX.6. COIL SUPERVISION

It is an automatism integrated by 4 inputs and 2 outputs.

Inputs	Outputs
Trip circuit with breaker open	Trip circuit failure
Trip circuit with breaker closed	Closing circuit failure
Closing circuit with breaker open	
Closing circuit with breaker closed	

With the breaker closed if the input "Closing circuit with breaker closed" is deactivated, after 20 seconds a closing circuit failure must be shown and that output will be activated. If then the input is activated, after 20 seconds the failure output must be deactivated.

With the breaker closed if the input "Trip circuit with breaker closed" is deactivated, after 20 seconds a trip circuit failure must be shown and that output will be activated. If then the input is activated, after 20 seconds the failure output must be deactivated.

With the breaker open if the input "Closing circuit with breaker open" is deactivated, after 20 seconds a closing circuit failure must be shown and that output will be activated. If then the input is activated, after 20 seconds the failure output must be deactivated.

With the breaker open if the input "Trip circuit with breaker open" is deactivated, after 20 seconds a trip circuit failure must be shown and that output will be activated. If then the input is activated, after 20 seconds the failure output must be deactivated.

XX.7. CHECKING OF THE DISPLAY AND CLOCK OPERATION

Connect the relay to the power supply. Check that the bicolor led **Ok/F** is shown in green. On the display it must appear the following text:

PL70XY **Cod /vers**

XY defines the model family (for example IT).**Cod** indicates the 3 first digits of the model commercial code, **vers** indicates the firmware version. By pressing INTRO it should appear

SEE TIME

By pressing INTRO again there will appear the date on the first row of the display and the time, the unit has, will appear on the second row. Check that the seconds digits change.

##/##/## **##:##:##**

Turn off the unit and wait 1 min. Return to "See time" and check that the time indicates 1 min more than when it was turn off, which indicates that the battery is working well.

Press ESC. It should be seen

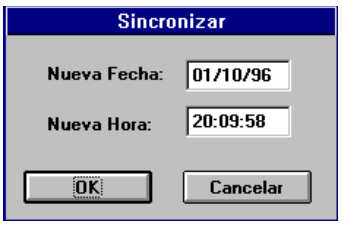
SEE TIME

Press ESC. It should be seen again

PL70XY **Cod /vers**

XX.8. TIME SETTING OF THE UNIT

Press the key 'Synchronize' shown on the upper part of the "Status", in the Protection console. A window with the PC time and date will appear.



Press OK and check that the relay receives the date/hour which has been sent.

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